David B. Greenberg

RAISING GAME BIRDS IN CAPTIVITY

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FOR LOUIS BROMFIELD

For whom the soil is a song
and conservation a prayer.

Author's Foreword

THERE ARE CERTAIN FUNDAMENTAL PRINCIPLES AND PRACTICES, WHICH underlie the successful production of all kinds of game birds. Rather than repeat these under the chapters dealing with the various species, I have chosen to discuss them in their general aspects, and to note deviations either in the general chapters, or call attention to them when writing about specific birds. For example, the general principles of sanitation in regard to brooders apply to the rearing of all game birds, as they do in domestic fowl production. I have therefore discussed them in the general chapter, and refrained from repeating them later, except where I thought repetition was necessary for the sake of emphasis.

Under the general chapters may be listed:

Artificial Incubation
Artificial Brooding
Hatching and Rearing with Bantams
The Nutrition and Feeding of Game Birds
Wing Clipping, Pinioning, and Brailing
Predators and Their Control

The raising of Hungarian and Chukar Partridge is so similar to the methods employed in raising Bobwhite Quail that I have not felt it necessary to devote much space to these species.

Beyond discussing nutritional diseases in the chapter on "Nutrition" I have felt that a section dealing with diseases of game birds would be superfluous in this book.

Proper feeding and sanitary methods will eliminate the danger of many diseases. Prompt isolation of sick birds will prevent the spread of most dis-

eases. In many states the Conservation Commissions will cooperate in the diagnosis of game bird ailments. A list of these commissions is given in the appendix.

Busy breeders can hardly be expected to acquire the knowledge requisite to diagnose and cure ailing birds. Those who are ambitious and wish to pursue the subject further can write to the Fish and Wildlife Service, of the U.S. Department of the Interior, Washington, D.C. for Conservation Bulletin 21—*Diseases of Upland Game Birds.*

It may be well to note at this point that almost all upland game birds are raised on wire, or at least off the ground, except pheasants. There are, however, occasional instances of quail being raised on the ground, where the soil is sandy. Both methods are used. In the chapters on pheasants, I have dealt with the ground method of rearing. In dealing with the other upland game birds I have concerned myself with the over-the-ground pen methods.

Permission to raise game birds must be obtained from the conservation commissions of the several states. Permission must also be obtained to market the finished products, either alive for stocking purposes, or dressed for food. The laws vary considerably from state to state and should be noted carefully by those who intend to raise birds commercially.

In the writing of this book I have relied not only on my own experience, but have interviewed and corresponded with some of the leading game producers in the United States. I have gone through almost all of the literature on the various kinds of game birds and have used the findings of others (always with the permission of the authors), because I felt that no one individual could possibly be an authority on every phase of this fascinating subject. Prominent breeders have gone over and checked the parts of the book dealing with their individual specialties, and in many cases have made valuable suggestions. Others have been kind enough to furnish me with photographs dealing with the subject.

I am particularly grateful to Mr. Ralph B. Nestler, Associate Biologist, of the Bureau of Biological Survey, who was not only generous enough to permit me to quote extensively from his outstanding contributions to the subject, but was extremely helpful in placing at my disposal reprints on his original experimental data.

Mr. C. R. Gutermuth, Vice-President of the Wildlife Management Institute at Washington, D.C. was kind enough to furnish me with numerous photographs and permit me to use material from the various publications of the Institute.

The Fish and Wildlife Service of the U.S. Department of the Interior have issued valuable bulletins on game bird propagation and were good enough to furnish me with photographs from these. I have made free use of some of the material contained in their literature.

I wish to thank Mr. Louis Bromfield and Prof. Bergen Evans for permission to quote from them in one of the opening chapters. Thanks, in this connection, are also due to their publishers, Harper & Brothers.

Prof. Alexis I. Romanoff of Cornell University placed at my disposal his valuable data on incubation of game birds, and I gratefully acknowledge my debt to him.

Mr. Roger M. Latham of the Pennsylvania State Commission was kind enough to permit me to use his discovery of a method of sexing day-old pheasant chicks, for which I am deeply appreciative.

Both the Wisconsin and Pennsylvania Game Commissions were most cooperative in furnishing me with photographs and plans for pheasant houses and yards.

Mr. Jack A. Stanford, Quail Biologist of the Missouri Conservation, furnished me with the photographs and the data pertaining to the age determination of quail. I herewith extend my thanks to him and the Missouri Conservation Commission.

To Mr. Ralph E. Yeatter, Game Specialist, State Natural History Survey Division at Urbana, Illinois, and the School of Forestry and Conservation of the University of Michigan, I extend my thanks for permission to quote from Mr. Yeatter's book, THE HUNGARIAN PARTRIDGE IN THE GREAT LAKES REGION.

Dr. U. P. Hedrick of the Geneva Experiment Station was kind enough to permit me a quotation from his interesting book, A HISTORY OF AGRICULTURE IN THE STATE OF NEW YORK, and to him I also extend my thanks.

Mr. & Mrs. J. L. Peyton of Duluth, Minnesota, specialists in goose raising, not only made available to me their valuable pamphlets on the subject, but were kind enough to go over the chapter on Waterfowl and make valuable suggestions. To them I am most grateful.

Mr. Donald J. Mac Farlane, owner of the Mac Farlane Pheasant Farms at Janesville, Wisconsin, not only supplied me with photographs but also checked over a chapter on pheasant raising. I am most appreciative of his help.

Mr. Irving Benjamin, Vice-President of the National Audubon Society, has been most helpful in putting at my disposal the library of the Audubon Society.

Mr. Fred H. Dale of the Michigan Conservation Department was generous enough to place at my disposal the experimental results of his work with Hungarian partridges, for which I am deeply grateful.

Harry Rodgers made available to me the results of his experience in thirty years of trapping. I wish to extend my thanks to him also.

Finally, Mr. Eugene V. Connett of D. Van Nostrand & Co. has been of invaluable help in making various suggestions, and I thank him for his sympathetic encouragement.

Contents

List of Illustrations

1

The Importance of Wild Life in Nature's Scheme of Things

THE IMPACT OF THE WHITE MAN'S COMING ON THE CONTINENT OF NORTH America has manifested itself in many ways. The builders of railroads and cities, the farmers, who mined the soil instead of husbanding it, the loggers who felled the vast virgin forests, and the hunters and trappers who killed recklessly, without the restraining influence of game laws, all contributed to a disruption of the ecological laws of Nature. As a result, many animals and birds have become extinct. To quote from a brilliant article in the December 1946 issue of *Harper's Magazine,* written by Bergen Evans, "Agriculture, upon which all men are completely dependent, is a form of applied biology. It is a making use for man's benefit of the interrelations of living things. For plants do not grow just by themselves. They are an expression of the soil, the climate, the topography, the underlying formations, and the animal life of the regions in which they flourish. The pollinating bee, the aerating worm, and, above all, the putrefying bacteria are indispensable parts of the process of which the plant is only one manifestation."

What a sportsmen's paradise this country, even *east* of the Alleghenies, was in 1839, may be gathered from Thoreau's A WEEK ON THE CONCORD AND MERRIMACK RIVERS. . . . "Ducks by the hundred, all uneasy in the surf, in raw wind, just ready to rise, and now going off with a clatter and a whistling like riggers straight for Labrador." . . . "You shall see men you never heard nf hefnre, whnse names you don't know, going way down thrnugh the meadnws with long ducking guns, with water tight bonts wading through the fnwl-meadow grass, on bleak, wintry, distant shores, with guns at half cock; and they shall see the teal-blue-winged, green-winged-sheldrakes, whistlers, black ducks, ospreys, and many other wild and noble sights before night."

The word stool-pigeon to a member of the present generation means a prisoner who informs on another, but to an older generation it meant the decoy pigeon, which was tied to a stool, to attract the flock of passenger pigeons that flew across the skies in such numbers that they often blotted out the sight of the sun.* Lest this be considered an exaggeration, the following from Dr. U. P. Hedrick's HISTORY OF AGRICULTURE IN NEW YORK STATE is quoted:

"In occasional years flocks of millions of passenger pigeons visited the State, most often in early spring in search of food in the forest—acorns, beechnuts, and buds and leaves that had withstood the winter. At such times, skies, forests, fields were filled with pigeons. New York became a vast pigeonry. Early settlers were usually near starvation when winter was driven away and the miracle of pigeons was to them as manna to the Israelites. They gorged themselves on the dark lean meat of the mature birds and later on the butter-balls into which the squabs developed. A pigeon year and a pigeon roost were godsends to the parts of the State so favored. A clergyman in the early days in the Genesee country thanked the Almighty for pigeons, our daily bread."

Passenger pigeon.

The restocking of our country with various kinds of game birds is an immediate necessity for the farmer, and, by that token, an ultimate necessity for all of us. For each decade witnesses the introduction of one or more insect pests that shrivel crops and cause untold economic waste. It wasn't always this way in our fair land. In his book, COUNTRY CURED (Harper & Brothers), Homer Croy described a return to the farm on which he was raised. "The land doesn't yield as it did then. Fertilizer is going on it—something my father never dreamed of. *And there are a million bugs and insects busy at the corn and at the land, pests he never heard of.* The vast fertility of the prairie soil has been depleted."

*"We have twice a year the pleasure of catching pigeons, whose numbers are sometimes so astonishing as to obscure the sun in their flight. . . . Every farmer has a tame wild pigeon in a cage at his door all the year round, in order to be ready whenever the season comes for catching them." From LETTERS OF AN AMERICAN FARMER by Hector St. John Crevecoeur, written in 1765.

A futthet proof of the relationship of birds to the successful growing of crops is demonstrated in the chapter entitled, "My Ninety Acres" in Mr. Louis Bromfield's delightful book, PLEASANT VALLEY. Mr. Bromfield tells of his visit to a neighboring farmer. "I followed him along the fence row and presently he knelt and parted the bushes and beckoned to me. I knelt beside him and he pointed. 'Look!' he said, and his voice grew suddenly warm, 'Look at the little devils.'

"I looked and could see nothing at all but dried brown leaves with a few delicate fern fronds thrusting through them. Old Walter chuckled and said, 'Can't see 'em, can you? Look, over there just by that hole in the stump.' I looked and then slowly I saw what he was pointing at. They sat in a little circle in a tiny nest, none of them much bigger than the end of one of old Walter's big thumbs—seven tiny quail. They sat very still not moving a feather, lost among the dry brown leaves. I might not have seen them at all but for the brightness of their little eyes.

" 'Smart!' he said, with the same note of tenderness in his voice. 'They know! They don't move!'

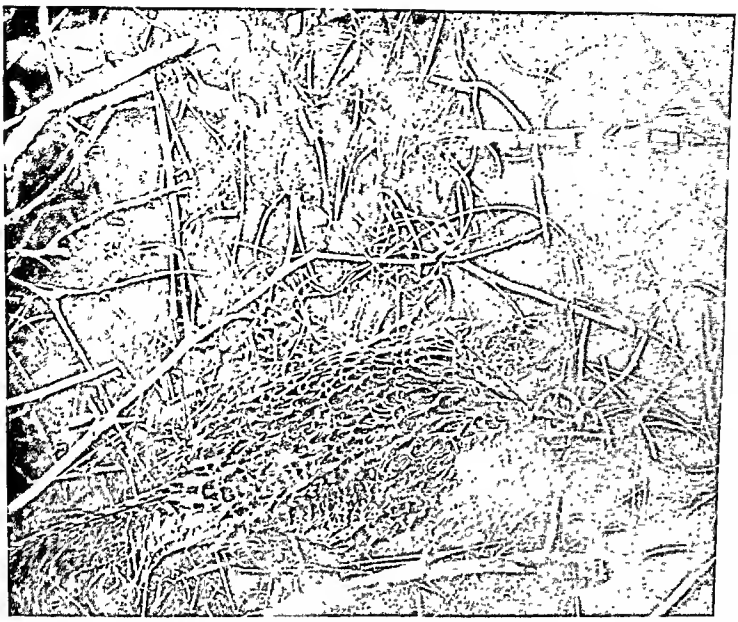
"Then a cry of 'Bob White!' came from the thick, fragrant clover behind us and Walter said, 'The old man's somewhere around.' The whistle was repeated, again and then again.

"Old Walter stood up and said, 'They used to laugh at me for letting the bushes grow up in my fence rows, but they don't any more. When the chinch bugs come along all ready to eat up my corn, these little fellows will take care of 'em.' He chuckled, 'there's nothing a quail likes as much as a chinch bug. Last year Henry Talbot, down the road, lost ten acres of corn all taken by the bugs. Henry's a nut for clear fence rows. He doesn't leave enough cover along 'em for a grasshopper. He thinks that's good farming, the old fool!' and the old man chuckled again.

"We were walking now up the slope from the creek toward the house, and he went on talking, 'That fence row beside you,' he said, 'is just full of birds—quail and song sparrows and thrushes—the farmers' best protection.' "

It would seem incumbent upon us, therefore, that vigorous steps be taken immediately to restock our fields and streams and partially, at least, to restore to nature what we have wantonly taken away from her, so that future generations may enjoy the products and the productivity of a regenerated countryside.

Farmers who preserve existing hedgerows or plant new ones can do much toward the restoration of an active game bird population. The recent introduction of multiflora rose hedges which serve as a living fence, growing six feet wide and eight feet high, present a barrier which neither horses, cattle nor sheep can penetrate. Some growers even claim that hogs cannot go through them. These hedges are on the whole more economical than post and



S. C. S.

Hen pheasant nesting in brush pile.

barbed wire fences and entail no upkeep once firmly established. Moreover, they offer a perfect haven for all kinds of game birds.

Farmers can also help by growing small patches of small grains which are left unharvested through the winter, to provide food when the ground is snow covered. Leaving a small stand of corn in shocks for birds to harvest is a good way to provide additional game around the farm.

Many sportsmen now raise game birds and let them loose on their own country places. If sufficient numbers are raised to allow for natural reproduction, there is a prospect that our game birds will not become as extinct as the dodo.

Many conservation committees are now encouraging the 4-H clubs to raise pheasants. By impressing the younger generation with the principles of game conservation, a long step forward has been taken.

There is, however, a fly in the ointment. Many sportsmen are beginning to believe that game birds raised in captivity haven't the capacity to endure in the wild. In states where there is a reasonable degree of accurate reporting

of the number of game birds shot, there is still a wide discrepancy between those numbers and the number of birds still around and this in spite of the large numbers freed by the conservation committees. Control of predators may be one answer. Limiting further the shooting seasons until game birds have a better chance to perpetuate themselves may be another. The encouragement of domestic propagation to a degree where there will be so many birds that a reasonable number may survive seems to be the most hopeful possibility; or a combination of all of the above methods may be necessary.

As this book is being completed in the fall of 1948, vast numbers of aigrettes have appeared in the northeastern section of the United States. These large flocks haven't been seen for fifty years. And it was fifty years ago that laws were passed, forbidding the use of aigrette feathers for millinery purposes. This is the answer to a conservationist's dream.

In some states limitations on deer hunting have resulted in an overproduction of deer to a point where they have become a nuisance. It will take a long time, if ever, to reach this saturation point as far as game birds are concerned. At any rate, it's a point to shoot at.

2

The Business of Farm Game Bird Production

THE PRODUCTION OF GAME BIRDS ON FARMS OFFERS AN OPPORTUNITY IN a field that is not now overcrowded and is unlikely to be so for many years to come. Prophecy is always a dangerous thing, but in this particular instance, I feel that I am justified in making the assertion that no matter how many people go into the breeding of game birds, the prospect of introducing new species is only limited by the numbers of *rarae aves* to be found in the jungles of Asia, South America and Africa. Nearer at hand is the ruffed grouse of our own continent, which to date has baffled the breeders of this country, who have tried to raise it in confinement. It is true that a few ruffed grouse have been brought to maturity domestically, but the costs have been prohibitive. Someday, someone, who has had considerable experience with other game birds, may hit upon the formula for extensive propagation of Grouse on Farms.

At present the combined results of private breeders, state conservation commissions, and 4-H Club youngsters fail to produce enough game birds to satisfy the sportsmen of America, who are constantly lamenting the shortage of game. More and more restrictions of the open season bring forth loud complaints from the hunting public.

As this book is being written the Federal Government announces that $1,722,677 worth of duck stamps at $1 each were sold during the twelve months ending June 30th 1948. The stamps did not sell as well as they did the two preceding years because of the drastic nature of the hunting regulations in the fall of 1947.

These stamps are for the hunting of waterfowl only and give some indication of the need for more farm production of wild waterfowl. The fall in sales of these stamps over previous years, due to shortening of the open

season and bag limits, points up to the necessity of providing more wild waterfowl for the many who enjoy hunting them. The raising of wild waterfowl in captivity, however, is only part of the problem. The cooperation of Federal and State agencies, as well as nature lovers in the preservation of nesting areas and wintering grounds, is required to bring back the supply of wild ducks and geese as our fathers knew them. Otherwise more drastic curtailment of the sport will be imposed.

In some cases the government has found it necessary to forbid the hunting of certain birds altogether. Writers in sportsmen's magazines bewail the plenitude of game which abounded when they went hunting as boys with their fathers. Each year brings an increasing population and more hunters among them,—and a decrease in the amount of game.

Not only is there a natural increase in the population, but the trek from the cities to "that little place in the country" is apparent to anyone watching the stream of cars on the roads, now that the five-day week permits a long week-end. And many of these urbanites soon learn from their country cousins and neighbors the lure of the fields and streams and that means more fishermen and hunters. The enormous advertising of the out-of-doors industry, and the many magazines devoted to hunting and fishing have made a multitude of converts out of urbanites. All this means a market for the products of game bird producers. Nor is this all. Many hotels and clubs are customers for all sorts of dressed game birds to serve their gourmet clientele. Canned pheasant à la Newburg, mallard stew, pheasant broth and duck soups have already found their way to the market in tins.

Before enlarging on the possibilities in game bird production, I feel it necessary to issue a warning that this industry is not a catch-all for city failures, nor is it a refuge for those, who are tired of the city and "want to get away from it all." Still less is it an opportunity to get rich quick. Game bird farming is a business like any other business, in that it requires a certain amount of capital, a thorough knowledge, and extreme caution in building up.

The city merchant or manufacturer deals with inanimate things, and when he closes up his shop or factory at night can expect to find things pretty much as they were the next morning. The prowling fox, the raccoon, or the hawk are no concern of his. Nor does disease affect his product. The game breeder, like the farmer, must be something of a veterinarian, a chemist, a botanist, a carpenter, a plumber, and an all-around handy man. He must know his markets and something of cost accounting. To be successful he must have most of the qualifications of a successful city business man plus the powers of observation that are required to contend with the forces of nature.

This all may sound formidable and forbidding to a beginner, but there is no reason why anyone with a reasonable amount of common sense, a love of

country living and a willingness to work hard cannot succeed, if be follows the rules, starts small, and expands gradually. There are many game farms in existence now which are moderately large and afford a modest living. Others are the part-time hobbies of men who depend on other occupations for their main source of income, and yet earn additional money from their game birds.

For those who are interested in the possibilities of big money in game bird production, let me cite the record of the Fox River Valley Game Farms, Inc. of Kaukauna, Wisconsin, Mr. Frank Van Zeeland, manager. This pheasant farm operates incubators with a capacity of over 48,000 eggs. They hold over 4,000 breeder hens yearly and ship out annually approximately 100,000 baby chick pheasants and 40,000 mature birds. It is hardly necessary to add this business is the development of many years.

Some experience in the raising of domestic poultry is a valuable asset for prospective game bird producers. A beginner might be well advised to start by raising hens, duck or geese for a year before he ventured into game bird production. The cost of these is far below game birds and any losses incurred would be minimal. With this experience, the next year could be devoted to game birds on a *very small scale*. Complete eradication of any trace of domestic fowl production is a prime essential once the game bird production is started, as the latter are highly susceptible to diseases which domestic fowl throw off. Plowing up the runs, sterilizing the utensils, incubators and brooders are "musts" before the conversion takes place.

To come back to the opportunities. Many game bird breeders have combined their business with hunting privileges. Large areas on their farms are stocked, dogs supplied and the hunting privilege allowed with a guaranteed "bag." As much as $25.00 a day is charged for the shooting privilege. A number of these hunting places also provide hotel accommodations and thus have an additional source of revenue.

The game breeder may specialize in one type of bird or several. Beginners would do well to start with only one kind. Even with only one kind there are specialties. For instance, one can make a business of selling game bird eggs to other breeders. Or a market can be built up for baby chick pheasants, turkey poults, goslings, or the day-old young of any species. Partially matured birds also are in demand. Many producers sell fully matured breeders.

Now where does the demand come from? State conservation commissions are often on the lookout for all sorts of game birds. Shooting clubs furnish another outlet. Menageries throughout the country often look for replacements. Other breeders, who wish to replenish their stock, in order to introduce new blood into their flocks, also provide a market. The millinery trade is in constant need of brightly colored plumage to adorn the hats of my lady fair. The 4-H clubs, organized to interest the younger generation in farming, often

raise game birds as one of their projects. And finally, the production of game birds for the large city markets is yet in its infancy. A few clubs and some swanky hotels and restaurants offer game birds on their menus, but the large eating public has scarcely been reached. How many of us have ever eaten game, that was purchased from a poulterer, at a dinner party or at our own homes?

Fortunately, in these days of ice-packs; rapid transportation, and cheap parcels post, a game farm does not have to be located near large centers of population. That means that one can start in regions where land is cheap. Indeed the large game farms are in most cases located "far from the madding throng."

Farmers, engaged in various branches of agriculture, may take on the raising of game birds as an additional "cash crop." The suburbanite may start in his own back yard, without much additional overhead and gain his experience at a low cost before venturing out on a larger scale. Quail, chukar, and Hungarian partridge lend themselves admirably to small scale production on small areas.

Unfortunately exact figures on the cost of going into game bird farming cannot be given. The variables are too many. The cost of land or a farm on which to start is dependent on the location, the type of house and the amount of land. The cost of housing the birds and the equipment depends on the raw material which is constantly in a state of flux. The price of feeds is changing daily. And so is the cost of the initial stocking, whether it be with eggs, chicks, or breeders. The smaller the bird, the less land required and the less expense for equipment.

It has been said that book farmers are only a bit worse off than farmers without books. A beginner would do well to read everything he possibly can about the birds he would like to raise. For that reason there is a large bibliography in the appendix.

3

Game Bird Classification

SINCE THERE IS CONSIDERABLE CONFUSION IN THE NOMENCLATURE OF upland game birds, we turn to the 1939 YEAR BOOK of the United States Department of Agriculture for our definitions. According to this authority, Gallinaceous upland game birds belong to the super-family Phasianoidea, of the order Galliformes. This super-family is divided into four groups:

(1) Grouse, ptarmigans, and the sage hen—the Tetraonidae family.
(2) American quails and Old World partridges—the Perdicidae family.
(3) Pheasants—the Phasiandae family.
(4) Turkeys—the Meleagrididae family.

Grouse

Of the Tetraonidae family, the ruffed grouse, commonly called partridge in New England and pheasant in the southern Allegheny states, is probably the best known generally. In this book we shall use the name grouse for this species. Experience has shown that the production of ruffed grouse in captivity is difficult. Adult native birds are too wild for domestication and propagated stock, brought to maturity, are too tame for planting in the wild.

quail, etc. In this book we shall concern ourselves only with bobwhite quail, which we will refer to as quail or bobwhites.

Old World Partridges

The European or Hungarian partridge, a member of the same family as the bobwhite quail, and the chukar partridge, a native of India and North China, are the species of partridge which lend themselves most easily to breeding in captivity. These species will be referred to in this book as partridges.

Pheasants

The ordinary game pheasant, called variously English pheasant, Chinese pheasant, Mongolian pheasant, ring-necked, and English ring-necked is a cross between the common pheasant (*Phasianus colchicus*), and the Chinese pheasant (*P. torquatus*). They were first successfully introduced into this country in 1881. Pheasants breed freely in captivity and are, with bobwhite quail, the two most commonly propagated species of game.

Wild Turkeys

Turkeys are native American birds and existed in a wild and domesticated state when they were first introduced to white men by the Indians. According to the American Ornithologists Union they are classified as follows:

Family: Meleagrididae (Turkeys)
Genus: Meleagris
Species: gallapavo

Varieties:

1. *Meleagris gallopavo gallopavo Linnaeus.* The Mexican turkey. Range, central Mexico.
2. *Meleagris gallopavo merriami Nelson.* Merriam's turkey. Range, mountains of southern Colorado, New Mexico, Arizona, western Texas, and northern Sonora and Chihuahua, Mexico.
3. *Meleagris gallopavo intermedia Sennett.* The Rio Grande turkey. Range, middle north Texas to Coahuila, Neuva Leon, and Tamaulipas, Mexico.
4. *Meleagris gallopavo osceola Scott.* The Florida turkey. Range, Florida at least as far north as Gainesville.
5. *Meleagris gallopavo silvestris Vieillot.* The eastern turkey. Present range, southeastern United States to eastern Oklahoma, eastern Texas, central Missouri, central Kentucky, West Virginia, central Pennsylvania and northern Florida: formerly to Kansas, Nebraska, southeastern South Da-

kota, southern Wisconsin, southern Ontario, central New York and New England to southern Maine.

Aquatic Game Birds

There are many species of wild geese and ducks, but the most frequently raised are the Canada geese and mallard ducks. The method of raising these will be discussed in this book. However, the same principles apply to the rearing of the various other varieties of ducks and geese.

4

Artificial Incubation

Selection of Eggs

The beginner who is purchasing eggs for incubation should use discrimination in selecting a breeder, and preferably find one in his own vicinity. With a reliable breeder, there is some assurance that the eggs have been selected from vigorous, healthy parents. Such eggs will not only hatch more readily, but the offspring will inherit the vigor of the parents. A good breeder selects only the eggs from well-fed and properly mated birds. The beginner is more or less dependent upon his dealer for the reliability of the above factors. However, there are some considerations which he can judge for himself: (1) The eggs should be normal and uniform in size; undersized eggs will invariably produce small chicks, and oversized eggs relatively big ones. It is advantageous to have uniformly-sized chicks in a hatch so that they may start off on an equal basis, with less likelihood of an unequal competition for food. (2) Better results are obtained from eggs of normal shape; oddities in egg shapes should be discarded. (3) A good shell texture, and if possible a fair degree of uniformity in color, are desirable. To test the texture, the beginner should rub his hands lightly over the egg to feel for rough spots which may be thinner than the smooth portions of the shell.

Care of Eggs Before Incubation

Wherever possible, fresh eggs should be used for incubation in preference to eggs which have been held for some days. Sometimes it is necessary, however, to keep eggs for a week or ten days in order to get a sufficient number to put in an incubator. Under no circumstances should the eggs be kept longer than ten days. Eggs which are to be saved for hatching should be stood up

in vertical position, with the blunt end up, in a cellar or storeroom where the temperature is about 50 to 60 degrees Fahrenheit and the relative humidity 60 to 70 per cent. (The air space in the egg is at the blunt end.) A well-ventilated room free from dust and strong odors is desirable.

The eggs should be turned or tilted at about a 45 degree angle at least once a day. Under natural conditions, the hen turns the eggs around as she moves about in her nest, which prevents the embyro from adhering to the shell. An ordinary egg crate may be utilized for holding and turning the eggs. The turning may be accomplished by placing a piece of wood two by four inches, or a brick, under one end at the bottom of the crate. The slope of the crate may be reversed, and the eggs turned, by placing the two-by-four at the other end of the crate. If the eggs are stored in bran, the container may also be tilted up. Sometimes when eggs are placed in shallow trays and covered with bran, it is necessary to turn each egg individually. Bran or wood shavings between the layers of eggs provide a soft bed and prevent breakage.

The Incubator Room

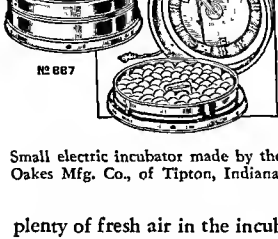
On commercial poultry and game farms, incubator rooms are usually located in specially built cellars, the greater part of whose walls are lower than the ground level. Enough space is left above the ground level so that windows may be provided to permit ventilation. The incubator cellar, in most cases, is the foundation for a superstructure which serves other purposes on the poultry or game farm. A cellar insures a minimum variation in humidity and temperature, since the surrounding ground acts as insulation. Furthermore, the cellar is protected from the sun's rays. It is important to prevent the rays of the sun, coming in through the windows, from striking the incubator.

The beginner, however, does not have to build a special incubator cellar. In fact, it would be extremely inadvisable to invest the large sum of money required for a special structure. A section of a house cellar unaffected by the heating unit can be utilized. If necessary, part of the cellar can be shut off from the warmer portion by a wall made of hollow tile or hollow concrete or cinder blocks. Provision must be made for ventilation, since fresh air is vital to the developing young embryos.

Selection of an Incubator

There are many different types and makes of incubators on the market, ranging from very small to mammoth units that cost thousands of dollars. Before investing heavily in a very large incubator, the beginner should try his hand at operating the smaller type. By its simplest definition, an incubator is merely a well-ventilated box which is heated, as a substitute for the natural

warmth of the mother hen's body. Since the hen provides not only heat but body moisture, and also turns the eggs as she hatches in the natural state, the incubator must also accomplish all of these functions. To regulate heat against outside temperature changes, an incubator should have a reliable thermostat which automatically controls the temperature. In small incubators, the thermostat is a sensitive wafer-like disc which expands and cuts off the heat when the temperature gets too high.



Small electric incubator made by the Oakes Mfg. Co., of Tipton, Indiana.

Kinds of Incubators

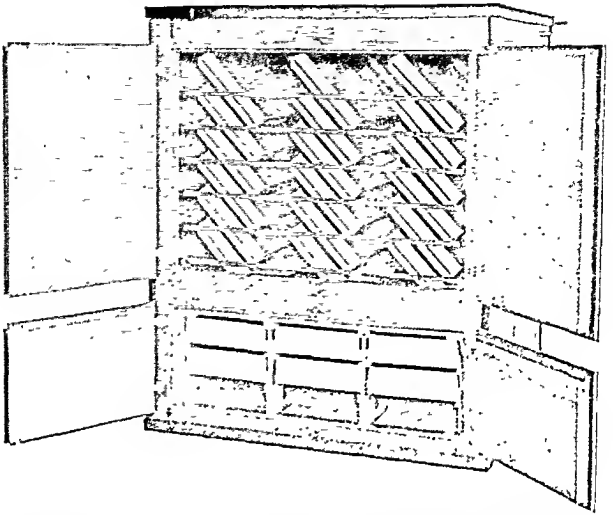
There are two general types of incubators. One is called the *still air* incubator. Air circulation in this type is based upon the principle that warm air, being lighter, will rise and be replaced by cold air, thus providing ventilation. The importance of plenty of fresh air in the incubator cellar is apparent, since the machine constantly demands more air as the hot air rises. The other type is a forced draft machine in which a power-driven fan is used to change the air in the incubator.

Incubators may be heated by coal oil, petroleum, gas or oil as well as by electricity. The trend today is toward the electric incubator. In the non-electric types hot water and hot air are the media used to transfer the heat to the egg chamber. The hot water system has the advantage of holding the heat longer, and being less susceptible to outside temperature changes. Electric incubators are heated by resistance coils in the egg chamber.

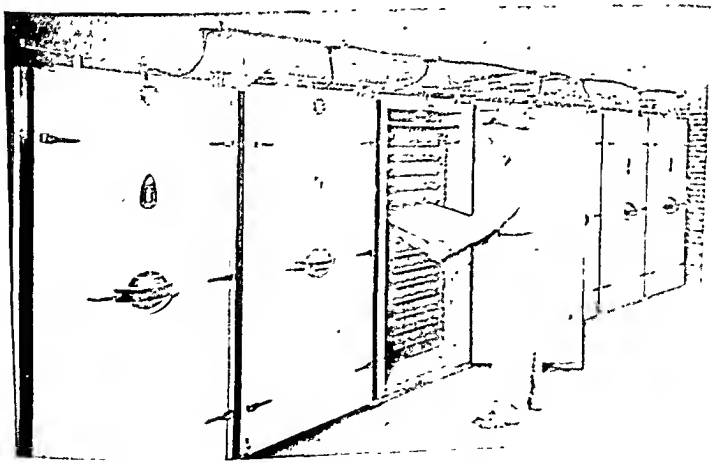
The methods of incubation vary to some degree according to the type of machine used, and the beginner's best guide is the instruction sheet issued by the manufacturer of the particular machine he is using. Practically all manufacturers are willing to help with advice during the course of a hatch.

Preparation of the Incubator

Since hot air rises to the highest point, the incubator must be absolutely level to insure an even distribution of heat. The water pans should also be level so that the entire surface of the pan is covered. This water provides the humidity necessary for incubation. Before the eggs are put in the incubator, the temperature should be thoroughly tested by placing the thermometer at several different points in the incubator. Thermometers should be tested against a certified instrument in a vessel of water at about 100° Fahrenheit. The bulbs of the thermometers should be at even level, and the water stirred gently. If there is a noticeable variation, a new thermometer should be pro-



"Baby Mammoth" Incubator made by the American-Lincoln Incubator Co. of New Brunswick, New Jersey. Notice the removable hatching compartment at the *bottom.*



Mammoth incubator made by the James Mfg. Co., of Fort Atkinson, Wisconsin

vided. Hydrometers which measure the humidity should be tested with a good standard sling psychrometer.

The exact temperature required for the incubation period varies not only with the kind of eggs being hatched, but also with the type of incubator used.

When temperature is referred to, it usually means that which is obtained when the bulb of a thermometer is level with the top of the eggs. Some manufacturers recommend a temperature of 102° for the entire period of incubation. Others vary this from week to week. Since other factors must be considered which have an effect upon temperature, such as ventilators and moisture trays, no fixed rules for temperature can be given.

An incubator operator should have some knowledge of what is taking place in the eggs he is hatching. He already knows that an egg will hatch only if it is fertile. A fertilized egg is a complete unit of life. The greater part of the egg is made up of reserve food material protected by thin membranes, and containing one very small spot which is the embryo or living matter. The yolk and the albumen are the food reservoirs. The albumen stores considerable water, and assists in the regulation of temperature, moisture and atmospheric gases. It also cushions the embryo against shock. Protecting the yolk and the albumen are two thin but tough membranes. Between them, on the blunt end of the egg, is the air cell. The egg shell protects the whole, and over the egg shell is an oil-like coating called the cuticle.

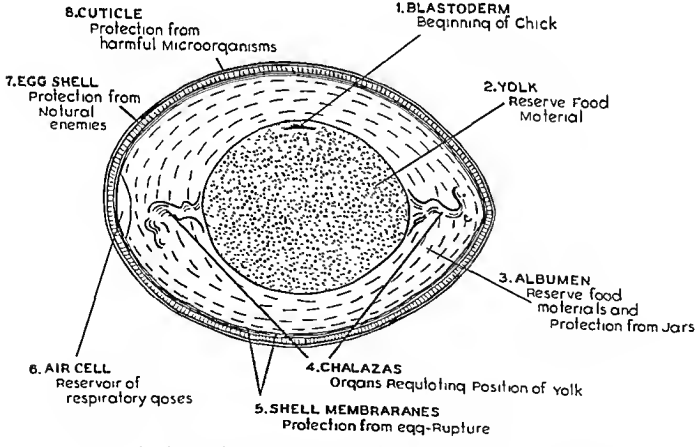
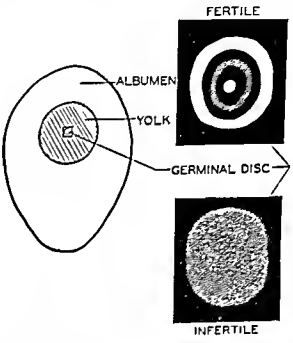


Diagram of a fertilized egg. Courtesy of Alexis I. Romanoff, Cornell University.

The composition of a bird's egg is complicated, and contains proteins, fats, carbohydrates, minerals and vitamins. These all combine to supply a complete ration for the growth and development of the embryo. The proteins are used for development of tissues such as muscles; fats supply energy and heat; minerals such as calcium and phosphorus go into the bone structure. Vitamins regulate the metabolism and health of the developing embryo.

Fertility of Ring-necked Pheasant Eggs

The question of cock–hen ratios for maximum fertility has long been a moot point among pheasant raisers. English producers have advocated one cock to five or six hens. Beebe noted ratios of four to eight hens in the harems of Chinese pheasants in their native habitats. Mr. Pierce E. Randall found a fertility of 94.1 per cent in the area in Pennsylvania with a sex ratio of one to seven hens. Mr. Charles Shick, on the basis of his investigations, believes that a single cock can easily service ten to twelve hens. Tests on the California Game Farm have shown that a ratio of one cock to 24 hens, or even one cock to 50 hens resulted in normal fertility.



Germinal disks of unincubated ring-necked pheasant eggs. Courtesy of California Fish and Game Commission.

H. Twining, H. A. Hjersman, and W. Macgregor of the California Bureau of Game Conservation stress in an article in *California Fish & Game,* the need for clearly defining the word "fertile". Ordinarily the word is used to apply to eggs that are capable of hatching. Embryologists, however, reserve this term for eggs in which fertilization has taken place, whether or not the fertilized ovum is capable of embryonic development. An egg with a dead germ would be classed as fertile. They point out that fertility can be determined by the examination of the germinal disc, and record an instance where 45 per cent of the eggs at a California game farm failed to develop. An examination of the samples of fresh eggs showed 100 per cent fertility. It was found that the hot sun had killed the germ before any visible signs of development.

The Determination of Fertile and Infertile Eggs

As shown in the illustration (taken from the same article quoted above) the infertile germinal disc is whiter than the fertile and its margins are irregu-

lar. There are many clear vacuoles usually concentrated around the edge of the disc.

The fertile germinal disc can be easily and quickly distinguished without the aid of a glass. The area opaqua (outer ring) is not an intense white. The disc is round or nearly so and the margins are clean cut. The area pellucida (center core) is often clear but frequently invaded by greater or lesser amounts of white material. One or more small vacuoles may occur on the periphery of the blastoderm (the developing embryo). The fertilized blastoderm at the time of laying consists of several thousands of cells in contrast to the unfertilized egg which undergoes no cell division.

It should be noted that the above determination of fertility cannot be made without breaking the eggs and is, therefore, useful only in discovering the reasons for the failure of a hatch.

Since there are considerable differences among the eggs of pheasants, grouse and quail, these must be considered in incubation. For example, large eggs incubated in a still-air machine require lower temperature readings than do small eggs. The stronger and thicker the shell, the less rapid the rate of escape of moisture from the egg. This factor also obtains in the care of eggs prior to hatching. The permeability of the egg shells to the air will determine how long the eggs can be kept before incubation. (That is why it is important in choosing eggs for incubation to follow the directions given earlier in the chapter.) In size, pheasant eggs, while differing widely from one another, will average about 32 grams in weight; grouse, 18 grams; quail about nine grams. Food and water storage capacity as represented by albumen is largest in the pheasant eggs, smallest in the quail. The condition is reversed in respect to the yolk.

Laying Period

Game birds raised in captivity are encouraged to early and long-continued laying periods. And there exists occasionally a brief period at the beginning of laying, and a relatively longer period near the end, in which there is a great amount of infertility. Fewer eggs are laid in the wild state, but there is less infertility. In the northeastern states, grouse and quail eggs are most fertile in April. However, this may vary in other parts of the country.

Loss of Weight in Incubating Eggs

Birds' eggs lose weight during incubation because of the escape of moisture through the pores of the shell. This loss can be detected either by periodic weighing of the eggs, or by measuring the increasing air cell with an ordinary candler. The loss of weight in eggs is influenced largely by humidity, temperature and air movement. A good method of determining the optimum

humidity is to start a hatch in an incubator at the same time as one is started under a hen. By candling the eggs in the natural method, and comparing the size of the air space with that of eggs in the incubator, the operator can determine whether he must increase or decrease the humidity in his incubator. If the air space in the incubator eggs is larger than that of the eggs under the hen, it shows that there is insufficient humidity. Of course, the porosity of individual egg shells will also have an effect upon the rate of evaporation. It would be well, therefore, to candle a number of eggs under the hen, and also a number in the incubator before coming to a definite conclusion.

The following data have been worked out by Alexis I. Romanoff, Gardner Bump and Earl Holm.

RELATIVE LOSS IN WEIGHT OF INCUBATED GAME BIRDS' EGGS AT A NORMAL TEMPERATURE AND AT ABOUT 65 PER CENT RELATIVE HUMIDITY

Observations	Pheasant (Ring-necked)	Grouse (Ruffed)	Quail (Bobwhite)
Average egg weight (grams)	32.0	18.0	*9.0*
Average daily loss in weight (gram)	0.21	*0.12*	*0.07*
Average daily loss per gram of egg weight	*0.0066*	*0.0067*	*0.0078*
Total loss in 21 days (grams)	4.41	2.52	1.47
Percentage loss of original weight	13.8	14.0	16.3

Computation of weight loss of eggs

The rate of loss in weight of eggs can be approximately determined by a simple method. In computing the loss in weight of eggs the following formula may be employed:

$$\frac{WL}{We} \times \frac{I}{D} \times 100 = \text{Percentage loss in weight}$$

WL—Weight loss (pounds or grams)
We—Weight of eggs at the time of setting (pounds or grams)
I—Incubated period of 21 days (from the time of setting)
D—Days of incubation at the time of weighing

Using this formula, one must proceed as follows:

A. At the time of setting
   (1) to weigh the empty tray
   (2) to weigh the tray with eggs

(3) to subtract the weight of the tray from the weight of the tray with eggs
(4) the result will be the *weight of eggs* at setting time.

B. After seven days of incubation:
(1) to weigh the tray with eggs
(2) to subtract the weight of the tray with eggs at seven days from the weight of the tray with eggs at setting time
(3) the result will be the *loss in weight* after seven days incubation.

Ex:—Weight of tray—4 lbs.
Weight of tray and eggs—14 lbs.
Weight of eggs equals 14 lbs. minus 4 lbs. or 10 lbs. at time of setting
Weight of eggs and tray on seventh day—13.5
Loss in weight equals 14 lbs. minus 13.5 or .5 lb.

$$\frac{.5}{10.0} \times \frac{21}{7} \times 100 = 15 \text{ per cent weight loss}$$

This loss in weight designates the total percentage loss which would have been reached at the given rate during the 21-day period. The eggs, having lost .5 lb. during the seven-day period, will actually lose 5 per cent of their weight during this period. If all conditions are constant, this rate of weight loss will be about 15 per cent at the end of the 21st day. Having the figures for the optimum total weight loss of eggs of different species of game birds (see table above), one can increase or decrease the rate of evaporation so that the optimum will be attained at the end of the incubation period.

Handling of the Hatch

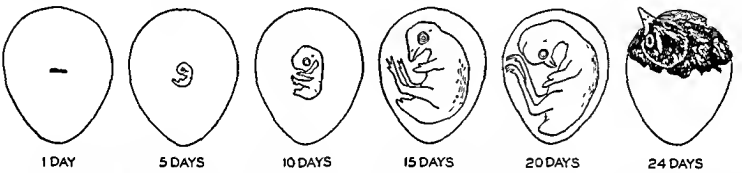
When the incubator has been tested and warmed, the eggs may be put in. The operator should never handle eggs with soiled or greasy hands, and the small end of the eggs should be down at all times. It is necessary to candle the eggs after seven days to determine which ones are fertile, and again at the end of 14 days to discover which embryos are living. They should be turned from three to five times each day. Infertile eggs should be removed on the seventh day, and dead embryos on the 14th day; these eggs decay and give nff a bad odor if allowed to remain in the machine. On the 21st day of incubation it is no longer necessary to turn the eggs.

In snme types of agitated-air incubators, the eggs should be transferred to a still-air incubator on the 21st day. This is only done in large operations, to avoid disturbance to eggs in various stages of incubation, and to prevent the agitatinn and circulation of the new hatched chicks' down from interfering wiih the rest of the hatch.

The eggs should nnt be disturbed at hatching time; the birds should never

be helped out of the shell. If they are not strong enough to get out of the shells unaided, they will not be vigorous, and any attempt to raise them will be simply wasted effort. The hatched birds should be removed from the trays only after the entire hatch is completed. Opening the incubator to remove a few newly hatched birds may change the environment to such an extent that it may prevent the remaining eggs from hatching.

In the larger hatcheries regular schedules are followed. The eggs are set at regular intervals, usually on a definite day of each week. For instance, if pheasants are set on a Friday morning, the hatch would then be completed by Monday morning, 24 days later. The work calendar can then be set up so that all eggs will be candled on a given day, and chicks taken off on a given day. Separate hatching compartments can be cleaned and disinfected in preparation for the next hatch.



Periodic changes in the form and size of the developing pheasant, grouse, or quail embryo. Courtesy of Alexis I. Romanoff, Cornell University.

Extensive experiments carried out by Romanoff, Bump and Holm, described by the New York State Conservation Department publication, brought forth the following conclusions concerning the incubation of game birds.

1. The average normal temperature for the incubation of pheasants, grouse and quail eggs is about 99½° F. in an agitated-air type incubator. From 101½° to 103½° F. to 104° F. for grouse and quail eggs, depending upon the make of incubator.

2. At a constant humidity and air movement, pheasant eggs require higher temperature at the beginning and lower temperature at the end of incubation, perhaps as much as two degrees F. difference.

3. At a constant humidity and air movement, quail and grouse eggs require almost constant or even slightly raised temperature, about one-half degree F., toward the end of incubation.

4. The average normal relative humidity for the incubation of pheasant, grouse and quail eggs is about 65 per cent in either agitated-air or still-air type incubators.

5. Pheasant eggs develop best if exposed to a higher humidity at the beginning and a lower one at the end of incubation. The reduction should be from about 70 per cent relative humidity to 60 per cent.

6. Quail eggs require somewhat lower humidity at the beginning and higher at the end of incubation, that is, rising from 60 per cent relative humidity to 70 per cent.

7. In practice it seems advantageous to incubate and to hatch quail eggs in a slow agitated-air type incubator.

8. Pheasant eggs that have been incubated for the first 20 days in an agitated-air type incubator may thereafter be hatched most successfully in a still-air type incubator with a slightly lower temperature (about one-half degree F.) and lowered relative humidity (about three to five per cent) from the average conditions recommended for the type of incubator where continuous hatching is practiced.

9. Quail eggs may be incubated and hatched most successfully in an agitated-air type incubator, provided that with an increase of air movement there is a corresponding increase in both temperature (up to one-quarter degree F.) and relative humidity (about two to three per cent).

10. The rate of exchange of oxygen and carbon dioxide is in proportion to the size of the embryo. Very little fresh air is needed at the beginning of incubation. However, it should be increased to an abundant supply at the time of hatching.

11. Pheasant, grouse or quail eggs should be incubated preferably in their natural position, that is horizontally, though they can be hatched successfully *in a vertical position*—blunt end up.

12. Turning from two to four times daily from the beginning up to the 20th day of incubation of pheasant, grouse and quail eggs should be sufficient.

Incubating Periods of Game Birds

Ring-necked pheasant—23 to 24 days.
Mongolian pheasant—24 to 25 days.
Bobwhite quail—23 days.
Partridges—22 to 23 days.
Silver pheasant—26 days.
Amherst and golden pheasant—22 to 23 days.
Reeves pheasant—23 to 24 days.
Turkeys—28 to 30 days.
Ducks—28 days, excepting Muscovy—33 to 35 days.
Geese—30 to 33 days.

5

Artificial Brooding

ONE OF THE EASIEST WAYS OF RAISING GAME BIRDS, AND AT THE SAME time the least expensive method, is to start with day-old chicks. Beginners should start with a small number, thus limiting their risks.

It is possible to secure day-old baby pheasants, quail and day-old mallards. Partridge baby chicks and baby goslings of the wild varieties are not usually available. For a list of dealers, write to your State Conservation Commission or see advertisements in such magazines as *Field and Stream, Outdoor Life, Sports Afield, Hunting and Fishing, Outdoorsman,* and *Fur, Fish and Game.*

Sexing Day-Old Ring-necked Pheasant Chicks

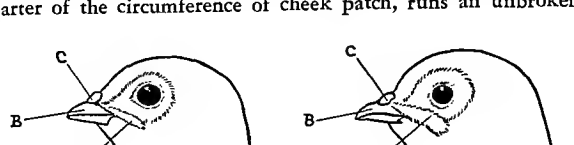
Mr. Roger M. Latham of the Pennsylvania Game Commission has discovered a method of sexing day-old pheasant baby chicks which will enable breeders to rear birds in any desired sex ratio. To date, the production of a thousand cock birds has necessitated the rearing of approximately two thousand individuals of unknown sexes to six or eight weeks of age, when the characteristic plumage differences are discernible. This new method is of economic importance to breeders who desire to raise only cock birds without going to the expense of raising the females also.

The anal method of sexing which is used in domestic chicks is a difficult one even for domestic fowl. In the case of pheasants it is even more difficult because of the smaller size of the chicks.

In the ring-necked chick, the shape and the extent of the cheek patch, or eye field, is used as the sex indicator. The variation in color and markings of the down are completely disregarded. In the day-old chick, the cheek patch of both sexes is entirely covered with natal down. This is shorter than that

covering the surrounding areas, thus producing a definite outline surrounding the eye field.

The down-covered field of the typical female chick is more nearly round than that of the male and in some instances forms an almost perfect circle. Extending from the nasal opening posteriorly downward along approximately one-quarter of the circumference of cheek patch, runs an unbroken, com-

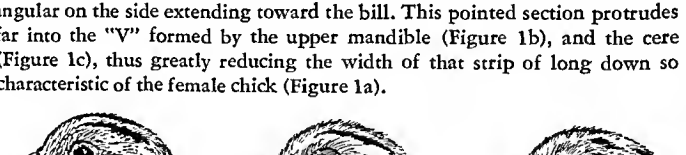


Outline drawn of day-old pheasant chicks showing male and female characteristics. A—strip of long down; B—upper mandible; C—cere. Courtesy of Roger M. Latham, Pennsylvania Game Commission.

FIGURE 1.

paratively wide strip of longer down (Figure 1a). This varies from about one-sixteenth to three thirty-seconds of an inch in width.

In the male, the eye field is rounded at the back of the head, but is definitely angular on the side extending toward the bill. This pointed section protrudes far into the "V" formed by the upper mandible (Figure 1b), and the cere (Figure 1c), thus greatly reducing the width of that strip of long down so characteristic of the female chick (Figure 1a).



Typical ring-necked pheasant chicks. Courtesy of Roger M. Latham, Pennsylvania Game Commission.

FIGURE 2.

Though not a positive indicator of sex, it may be helpful to know that in profile the line formed by the forehead and the upper mandible is usually more nearly straight in the case of males than among females. In other words, as a rule, the foreheads of the females rise more abruptly from the beaks than do those of the males (Figures 1, 2, and 3).

In addition to the individuals exhibiting either the male or the female eye

patches, a small percentage of chicks showed an intermediate type, exhibiting both male and female characteristics. In these individuals a portion of the eye field enters the "V" posterior to the upper mandible as in typical males, yet the strip of down immediately below is of sufficient width to be characteristic of females. To date it has been impossible to sex individuals of this type.

Typical ring-necked pheasant chicks. Courtesy of Roger M. Latham, Pennsylvania Game Commission.

FIGURE 3.

A 90 per cent accuracy or slightly better can be acquired with some practice, using the above tests on chicks removed from the incubator as the down on the head has thoroughly dried. Furthermore, the older the birds become, the more pronounced are the sexual characteristics, thus increasing the possible accuracy among such individuals.

Brooders

Any dry cellar with adequate ventilation *and free from rodents* can be utilized as a home for a brooder. In the early spring, a sectioned-off part of a barn or one of various types of brooder houses would be adequate. A brooder is a device which substitutes for the warmth of the mother hen's body during the early days of the young chicks' lives. A canopy or hover placed over a heating device constitutes a brooder. A small kerosene lamp, a coal stove, or a natural gas stove may be used to provide heat. However, with the rapid advance in rural electrification, most breeders find electric brooders the most satisfactory, especially those equipped with fans, which circulate and dry the bad air from underneath the hover. In large scale operations a series of overhead hot water pipes provided with an adequate cover furnish the proper brooding facilities. Battery brooders shown in the illustration are also used in large scale brooding.

Underfloor Radiant Heat for Brooders

One of the most promising developments in the brooding of game birds is the new radiant heating. So far, this heating method has not been utilized

by game breeders, but broiler raisers in Delaware, Maryland and Virginia have begun to make use of radiant heating in their brooder houses. After a few of the "bugs" have been eliminated it is quite possible that radiant heated central brooding houses will supersede colony brooder houses.

Hot water under forced circulation flows through heating pipes imbedded in a concrete or wooden floor. Wrought steel and wrought iron pipes, three-quarters, one, or one and one quarter inches in diameter are used. Copper one half inch pipes may also be used and are preferable because they can be bent more easily. It has been the experience of those who have installed radiant heating in their homes that the difference in temperature at floor level and ceiling level has only been .05° F. A boiler with a capacity of at least twice the radiating surface of the pipes is required. An adjustable aquastat on the boiler maintains the water temperature at from 120° to 180°. Depending on the size of the brooder room, one or more thermostats at a distance of 12 to 18 inches above the floor are necessary. Before installing this system, producers should consult the various companies who now manufacture radiant heating plants for homes. These organizations furnish free engineering service to prospective customers. It is important that brooder houses equipped with radiant heating should have insulated walls and ceilings and provision should be made for ventilation. A termite-proof insulating

Jamesway Battery Brooder. Courtesy of Hildebrand & Son, Seward, Nebraska.

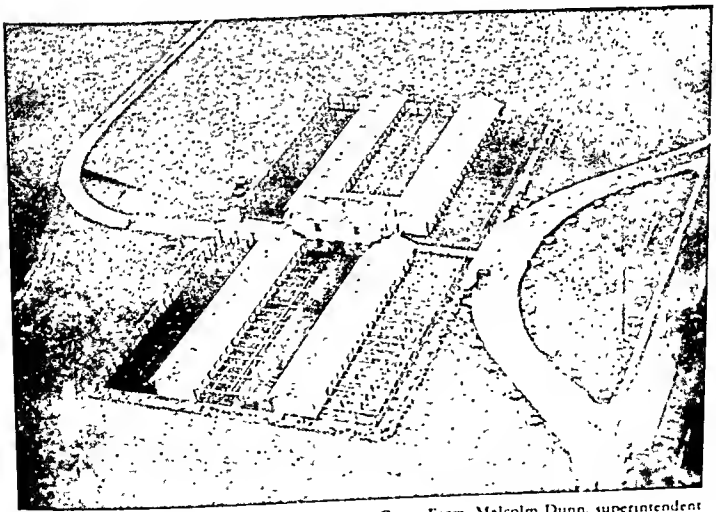
board should be placed under the pipes to reduce the heat loss downward. Insulation board should also be set against the inside of the foundation wall before pouring the floor slab.

In such large scale brooder operations protection against power failure during cold weather is necessary. Electricity is needed to operate the oil burner and the circulator motors. A small auxiliary generator for such emergencies is necessary.

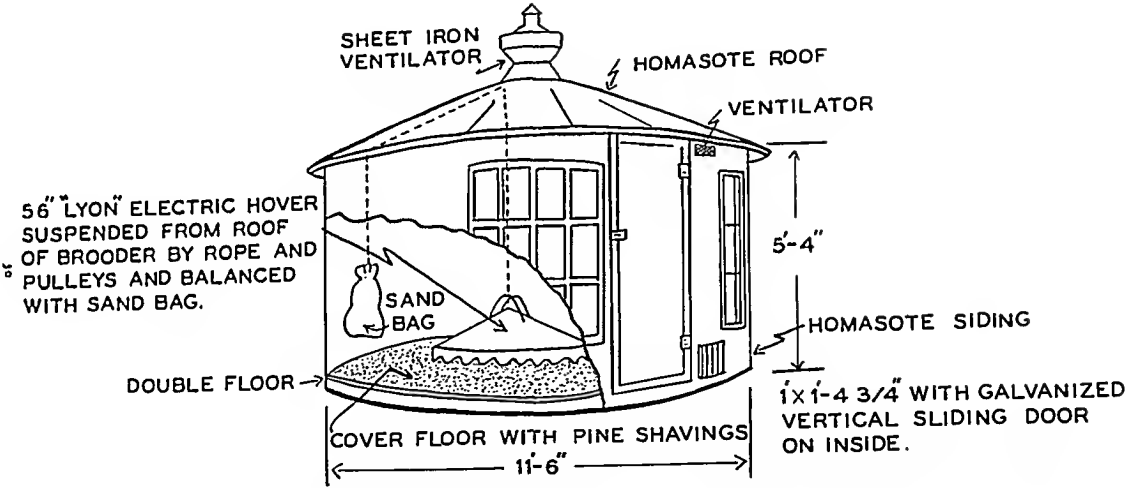
While the initial cost for radiant heating systems is high, there is considerable economy in operation over the old systems. As radiant systems are used more and more in home and poultry house heating, prices will undoubtedly come down.

The advantages of the system are economy in use of fuel, central thermostatic heat control, and a resultant labor reduction. Radiant heating keeps the litter dry and thus reduces the danger of coccidiosis. Further, dry litter lasts longer than wet and there is less need for replacement. Chicks will not wander away from the central heat source as they are apt to do in colony brooders, since the heat is evenly distributed over the entire brooding floor. Crowding is definitely eliminated. More chick space is available per brooder unit as there is no stove or heating unit in the center.

A more simple brooder can be made by inserting an electric bulb near the



Brooder house and pens on the New Jersey State Game Farm, Malcolm Dunn, superintendent



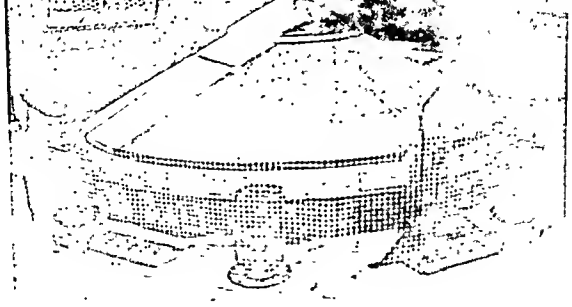
Pheasant brooder house: Floor space, 104 square feet; capacity, 200 to 250 chicks. Courtesy of Pennsylvania Conservation Commission.

apex of the hover. In such instances, where special brooding coops are made as in McCarty pens, no hover is necessary as the top of the brooder pen serves in that capacity. In most brooders, including the kerosene, coal and electric types, an automatic thermostat is supplied, which tends to keep the heat at a given temperature in response to temperature changes outside the hover.

Before the Chicks Arrive

Before the young stock arrive, the brooder should be tested thoroughly by starting it 48 hours in advance so that it will be warm enough when the young chicks are put in it. The temperature should be indicated by a small thermometer hanging just a few inches above the floor so that the approximate temperature at the level of the chicks' backs is about 98°. Young chicks of any species will gather near the source of heat or draw away from it, until they make an adjustment to the most comfortable temperature. Therefore, only a reasonable degree of accuracy is required in determining the temperature necessary for the different chicks, ducklings or goslings.

Brooders must also be well-heated before the chicks arrive, since early mortalities caused by chilling are common. Young chicks are kept in an incubator 24 to 36 hours after hatching and are not fed before they are removed to the brooder. They should be transported carefully to the brooder in a warm basket, box or other carrier. There are special cardboard containers on the market, sufficiently padded to keep the chicks warm, with perforations for adequate ventilation. Baby pheasants and baby mallards have been suc-



Brooder and guard rail. Courtesy of Wisconsin Conservation Commission

cessfully transported by parcel post and express. In the brooder house one-half a square foot of space is allowed per pheasant, but less for smaller game chicks.

Bedding

Many different materials may be used to cover the brooder house floor, such as wood shavings (never sawdust, because the chicks will eat it), straw or cut hay. Some breeders use five sheets of newspaper or brown wrapping paper on top of the shavings or hay, removing one sheet every day until the last sheet is soiled. Then the chicks are allowed to run around on the under covering.

A more satisfactory, although slightly more expensive method, is to use a white muslin or white feed bag material which can be removed each day, and a clean one substituted for it. The advantage of cloth over newspaper is that there is no tearing. If several pieces of cloth are used, the soiled one can be washed and used on alternate days. On white cloth the young chicks can readily find their food.

Guards

When the young stock is first placed in the hover, a guard made of cardboard, wire or boards should be put around, close to the sides of the hover, to prevent the chicks from straying too far from the source of heat. This practice should be followed for the first few days. If the weather is warm, the guards can be removed after the second day, but should be carefully replaced at night. The guard around the hover should be discarded when the chicks are about four days old and have learned to return to the source of heat. If the corners of the house are square, wire should be tacked around them on the inside to prevent chicks from piling in the corners and suffocating.

Temperature

If the chicks gather closely around the center of heat, it is an indication that the brooder is not warm enough, and there is danger of the birds crushing one another to death. If on the other hand they scatter to the perimeter, far from the center of heat, the brooder temperature is too high.

The temperature should be progressively lowered as the outside temperature increases, and also as the birds get older. Where electric brooders are used some sort of alarm system should be installed so that the game breeder will be instantly aware of an interruption in the current supply. Since sudden storms in the country frequently cut off electric service, some precaution should be exercised to provide a temporary heating system for the baby chicks. If necessary they can be placed quickly in a basket lined with burlap or part

of an old blanket, and carried into a room in the house where an equable temperature is maintained. (Usually this is in the kitchen.)

In recent years, the use of insulated brooder houses has become more prevalent, since the additional cost of the insulation is more than repaid by the savings in the cost of fuel. Moreover, an insulated house is less susceptible to sudden changes in outside weather conditions, and will be less precarious if the supply of heat should suddenly be cut off.

Ventilation

Water vapor and carbon dioxide are given off by chicks in fairly large amounts, and since these tend to accumulate underneath the hover of the brooder when curtains are used around the edge, it is important that the hover be raised a few times a day for several moments. This is usually done when inspecting the young chicks or providing fresh food and water.

Dry Litter

It is most important that the floor be dry and that the litter be changed frequently. Dampness is the cause of many diseases. Sometimes the brooder house may be too dry; in such cases, a pail of water hung in the brooder house in such a way that the birds cannot get at it, will supply the necessary amount of humidity. Different sections of the country vary in environmental factors. The dry plains of the southwest will require more moisture than coastal sections. The individual breeder will soon learn to take cognizance of his own environmental factors.

Disinfection

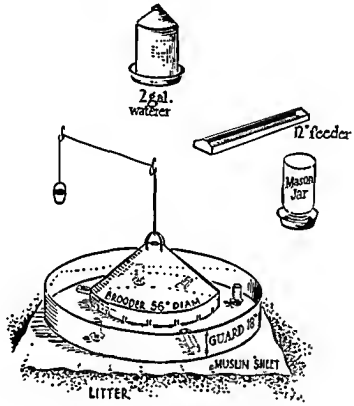
Many small feeders and watering devices are preferable to a single large one, to prevent the young chicks from starving or perishing from thirst because of their failure to find the utensils. Both feeding and watering utensils should be raised slightly above the level of the litter so that they will not become infected with bird droppings. The drinking water fountains should be thoroughly cleaned each day and replenished with fresh water. Feed hoppers should be examined for particles of droppings mixed with food.

After each batch of young stock has been taken from the brooder and preparations are made for another batch, the litter should be changed completely, floors disinfected with any creosote or carbolic derivative, or mixture of lye and water. Whitewashing the wall is good practice.

Before a new batch is put under a brooder, the water supply fountains should be thoroughly cleansed with boiling water to prevent the spread of disease. Frequent visits to the brooder house are necessary so that dead birds may be removed, sick birds isolated, and wounded birds protected. Where

there is toe-picking, the toes may be painted with tar or some disagreeable-tasting substance which is not poisonous.

An important provision which may properly be treated under the heading of sanitation is that of adequate floor space for the young chicks. Exact amount of space per bird is dependent on the species. Figure one-sixth square foot per quail chick, one-half square foot per pheasant, Hungarian or chukar, and three-quarters square foot per turkey poult.



Small brooder and feeding utensils.

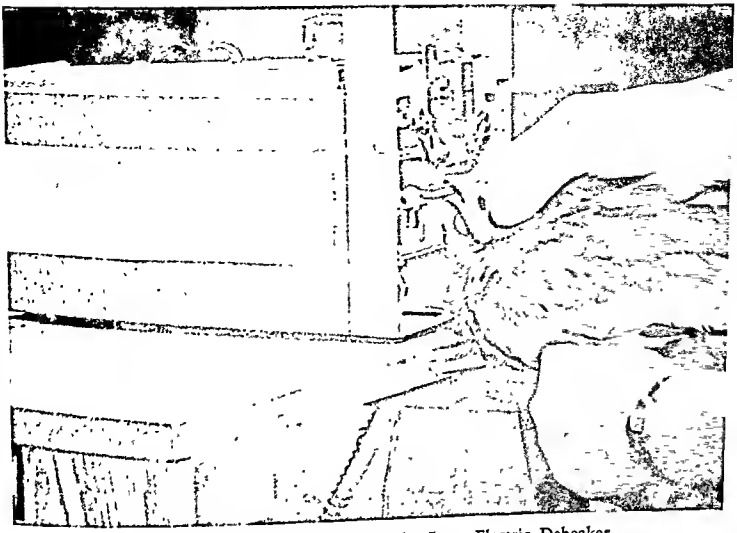
Cannibalism

A bit of food which is on a chick's body will often attract other chicks to peck at it; if blood is drawn there will invariably be renewed attacks. In order to prevent this it is well to have a head of lettuce or cabbage suspended on a string at a slight distance above the floor so that the young stock can exercise by jumping and pecking at the green food. This is not only a deterrent to cannibalism, but also provides needed vitamins and a succulent in the diet.

Some of the common causes of cannibalism and feather-picking are as follows: (1) improper feed or nutritional deficiencies; (2) temperature too high or too low; (3) overcrowding.

Utensils

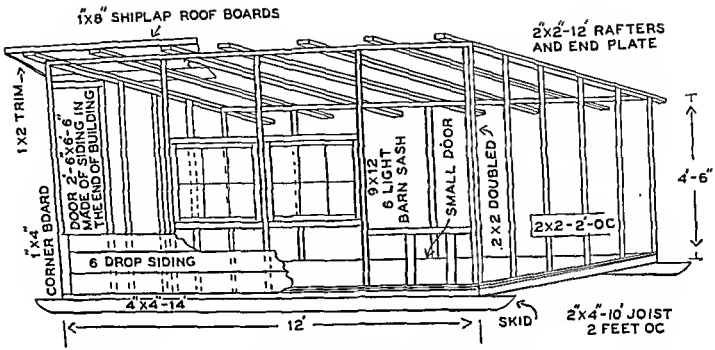
An ordinary inverted jar with a saucer slightly larger than the mouth of the jar; or an ordinary two-gallon poultry waterer made of galvanized metal:



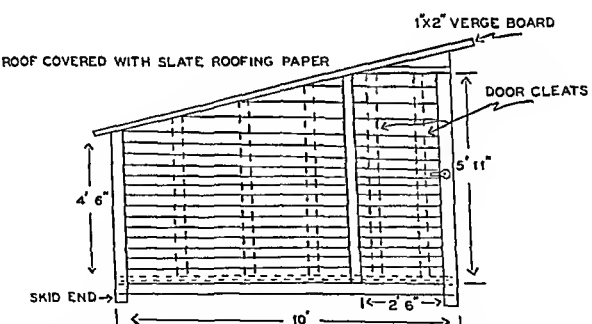
Debeaking a young turkey with the Lyon Electric Debeaker.

or even a pottery crock are suitable for watering the chicks. Several of these are necessary for a small brood. The greater the number of chicks, the more watering fountains should be used. Feed hoppers about twelve inches long, with an arrangement to prevent the young stock from climbing into the feed pan, can be made of wood or metal. The number of these used should be in accordance with the number of chicks. The homemade wooden hopper is the cheapest, but the metal ones are better because they can be scoured more easily. Both the watering fountains and the feeders should be elevated on a wire mesh platform to prevent infection of the feed and water by the scratched-up droppings which are mixed in the litter.

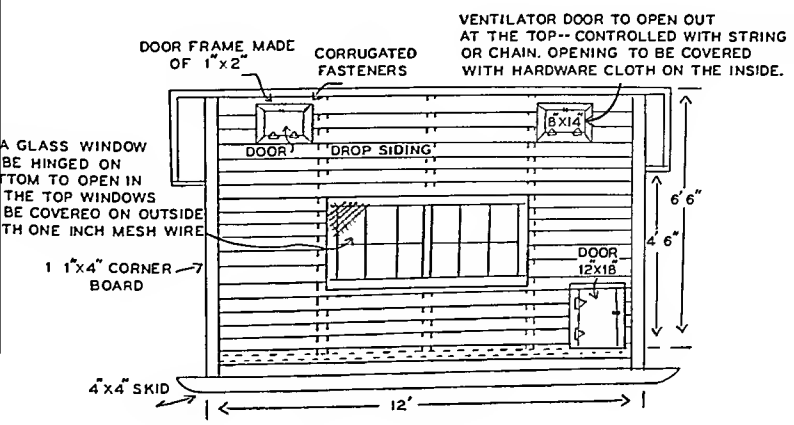
One fountain and one feed hopper should be supplied for every forty quail. For pheasant and partridge, one of each for every fifteen birds. Quail chicks are so small that they may drown themselves if the watering area is too large. Both fountains and feeders should be spread about in the feeding areas so that baby chicks can find them at various points. Pans for fine grit and dust baths should also be provided. The tops of preserve jars or glass coasters, with a slightly elevated perimeter are good receptacles for grit.



View of frame constructioo of brooder house (10' × 12', 300 capacity). Courtesy of Wiscoosin Cooservation Departmeot.



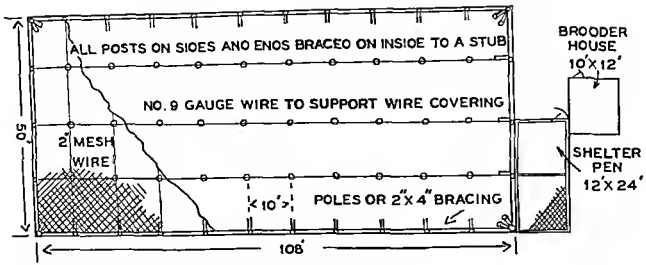
End view, showing large door, of brooder bouse. Courtesy of Wisconsio Conservation Department.



Front view of brooder house.

MATERIAL LIST FOR 300 SIZE BROODER HOUSE 10' × 12'

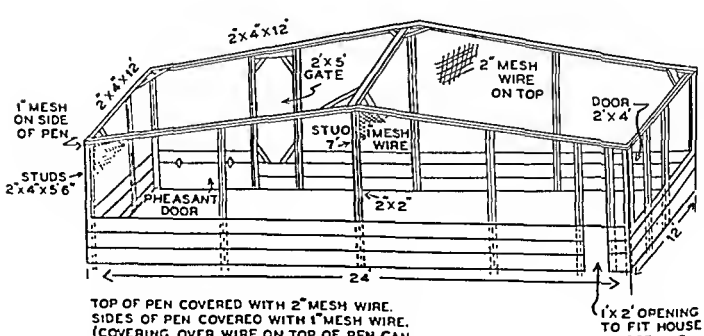
NO.	SIZE	KIND	USE
2	4"×4"×14'	#1 Fir	Skids
2	2"×4"×12'	#2 Hemlock	Sill
7	2"×4"×9'-8¾"	#2 Hemlock	Floor Joist
35	1"×8"×12'	#2 Hem. Ship	Second Floor—Flooring
21	1"×8"×14'	#2 Hem. Ship	Roof Boards
2	2"×2"×12'	#1 White Pine	Floor Shoe
2	2"×2"×10'	#1 White Pine	Floor Shoe
9	2"×2"× 5'	#1 White Pine	Short Studs—Framing
15	2"×2"× 7'	#1 White Pine	Long Studs
11	2"×2"×12'	#1 White Pine	Plate Rafters
28	1"×6"×12'	Drop Siding	Sheeting
32	1"×6"×10'	Drop Siding	Sheeting
2	1"×4"×14'	#2 White Pine	Corner Boards
2	1"×4"×12'	#2 White Pine	Cor. Bds.—Window Casing
2	1"×4"×10'	#2 White Pine	Window Jambs—Casing
2	1"×2"×14'	#2 White Pine	Roof Trim
2	1"×2"×12'	#2 White Pine	Roof Trim
2	1"×2"×10'	White Pine	Cas. for Vent Opening
1	1"×12"×3'	#2 Pine	Lit. Stop Across Door
1	1"×12"×28"	White Pine	Vent Doors
3 Pr.	3"	Strap Hinges	Window—Pheasant Door
4	2"	T Hinges	Vent Doors
1 Pr.	5"	Strap Hinges	Large Door
1		Safety Hasp	Large Door
168 Sq. Ft.		Green Slate	Roofing—Per 300
8 Lb.	8D	Common Nails	
3 Lb.	16D	Spikes	
2	9"×12"-6	Light, 1⅛"	Barn Sash



Brooder house, shelter pen, and covered run. Courtesy of Wisconsin Conservation Department.

MATERIAL LIST FOR COVERED RUN 108' × 50'

NO.	UNIT
67	7' Wood Posts, 4" Top
34	7' Wood Posts, 3" Top
22	2×4"×10' or Poles
330 Ft.	#9 Gauge Wire
2 Roll	(150') 1" Mesh, 72" Wide, 19 Gauge, Galv. Poultry Netting
6 Roll	(150') 2" Mesh, 72" Wide, 19 Gauge, Galv. Poultry Netting
2	2×4"×12' Pine
8	2×4"×14' Pine or Poles
1 Pr.	6" Strap Hinges
7 Lb.	Poultry Staples
15 Lb.	Hog Rings

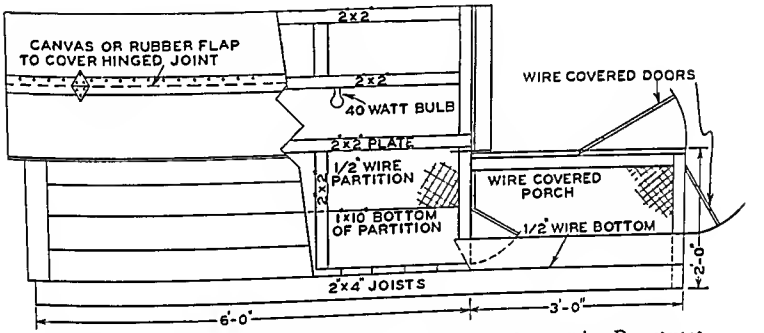


Shelter pen (12' × 24'). Courtesy of Wisconsin Conservation Department.

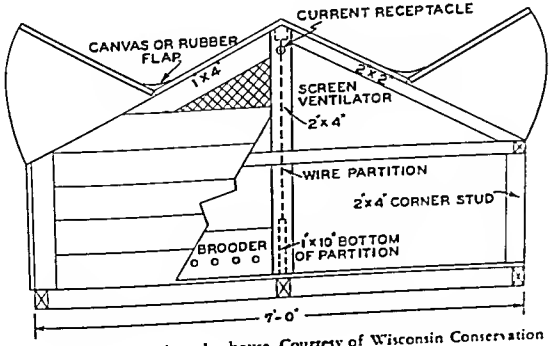
MATERIAL LIST

12' × 24' SHELTER PEN WITH GABLE ROOF

NO.	SIZE	KIND	USE
4	2"×4"×5'6"	#2 Hemlock	Corner Studs
7	2"×2"×5'6"	#2 Hemlock	Studs
5	2"×2"×6'	#2 Hemlock	Studs
8	2"×4"×12'	#2 Hemlock	Top
4	2"×2"×7'	#2 Hemlock	Center Studs
18	1"×8"×12'	#2 Hemlock	Base
3	2"×4"×16'	White Pine	Gates
72 Ft.	1" Mesh	5' Wire, 19 Ga.	Sides
48 Ft.	2" Mesh	6' Wire, 19 Ga.	Top
2 Lb.	Poultry	Wire Staples	
½ Lb.		Hog Rings	
3 Lb.	8D	Common Nails	
3 Lb.	16D	Spikes	



Side view of double brooder house. Courtesy of Wisconsin Conservation Department.



End view of double brooder house. Courtesy of Wisconsin Conservation Department.

6

Hatching and Rearing with Bantams

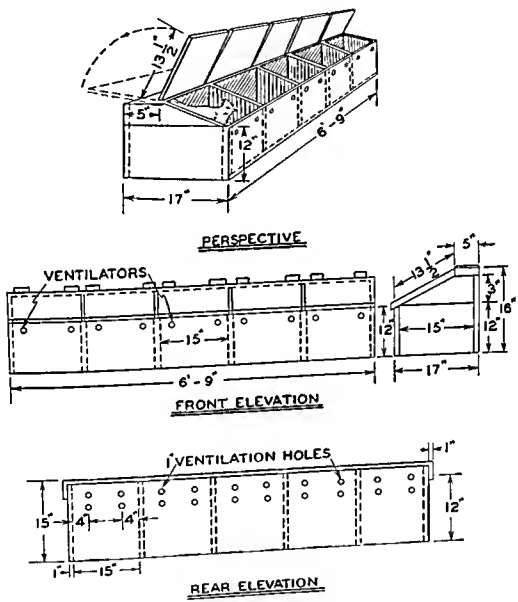
IN HATCHING WITH BANTAMS OR HENS, THE SAME PRECAUTIONS IN THE handling of eggs prior to setting are required as when the eggs are artificially incubated. Medium weight domestic hens, such as Rhode Island Reds and Plymouth Rocks, may be used for hatching pheasant eggs, but the lighter, nervous Mediterranean types, such as Leghorn and Minorcas, are entirely unsuitable. It is on the whole much better to use bantam hens (preferably Japanese Silkies) because they are small, light in weight and less likely to break the eggs or trample the young chicks. A supply of broody hens or bantams should be kept on hand, but at some distance from where the game birds will be raised.

A broody hen should be healthy and free from parasites such as body lice. She must also be of good disposition, since there are variations in the brooding qualities of individual birds. A bantam will cover from 12 to 15 pheasant or partridge eggs or 20 quail eggs. Domestic hens can handle as many as 15 to 20 pheasant or partridge eggs.

Hens become broody only at certain times. In choosing a broody hen, look for the following characteristics: breast feathers loose and missing; the hen sticks to her nest at night and does not go to roost with the others; when she is approached, she ruffles her feathers, clucks and picks at the breeder viciously. Once convinced that the hen is really broody, dust her carefully with sodium fluoride, applying the powder underneath the wings, on the back and breast, and around the vent. Dust the powder lightly into the feathers. Do not rub too hard, as too much sodium fluoride will chafe the skin. A ten percent D.D.T. powder, never a liquid, is also effective for dusting. Care must be taken not to get the powder in the hen's eyes or nasal openings.

In the course of brooding the hen should be dusted ten days later, but not

just prior to hatching, as the powder is strong enough to kill the newly hatched chicks. The Pennsylvania Game Commission recommends the use of pure pyrethrum powder just before the chicks are hatched. Mites as well as lice are a source of disturbance to the tranquillity of the brooding hen. Look for little specks on the skin; they may be felt on the hands after holding the bird from a mite-infested nest for a few minutes. If a mite-infested hen has been setting less than 13 days, it may be advisable to put the eggs in a new,



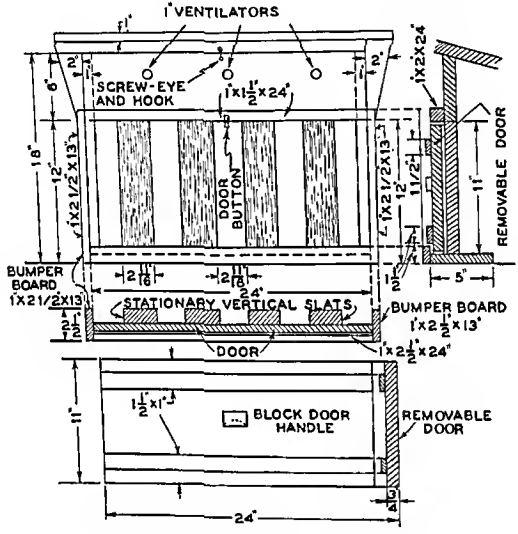
Setting boxes.

clean nest, and place a different setting hen upon them. The old nesting material should be taken out of the nest and burned, and the nest disinfected with creosote. If the eggs are past 13 days of incubation, they may be changed to a new nest and the same hen put upon them after the infested hen has been thoroughly disinfected. This change should be made during the heat of the day, when the temperature loss will not affect the eggs. Do not keep the hen off the nest for more than half an hour.

Mr. George S. McCarty, a prominent breeder of New Jersey, recommends the use of crude catechu (which can be had in any drug store), for the treat-

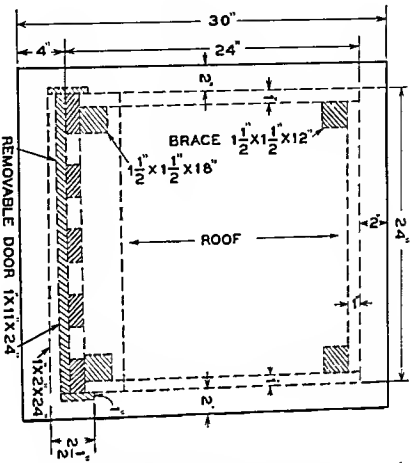
ment of worms. The rate is a level teaspoon of catechu to one gallon of water. One dose is given to the broody hen three days after incubation starts, another about ten days later. This dose is administered by forcing a teaspoonful down the bird's throat.

One of the great advantages of natural incubation is the fact that the operator can start without the expenditure for an incubator. A beginner can also start with one setting box, or with a series sufficient to accommodate

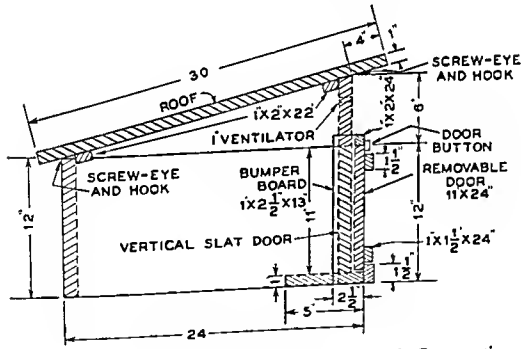


Front view of rearing coop, showing removable door. Courtesy of Pennsylvania Conservation Commission.

anywhere from five to ten hens. According to the plans of the Pennsylvania Game Commission, which are shown in the illustration, each compartment in a box should measure 14 or 15 inches square, 12 inches high at the front, 16 inches high at the back. This construction provides for a slanting, hinged, drop lid on top of each compartment. Ventilation holes are bored near the top (front and rear) of each division of the box. These boxes have no bottoms, and should be placed in an outbuilding or shed having a dirt floor. It is important that they be placed where there are no dogs or cats, and where they will not be disturbed by strangers. A brooding hen must be kept in quiet, or she may desert the nest.



Plan view of rearing coop. Courtesy of Pennsylvania Conservation Commission.

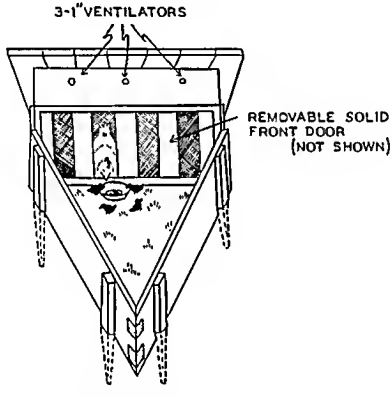


Side view of rearing coop. Courtesy of Pennsylvania Conservation Commission.

Setting boxes may also be placed outdoors in the shade of a tree, in an area which is fenced in to protect the hen from predatory animals. The boxes should be placed on level, moist ground, as game bird eggs require more moisture than chicken eggs. If the ground is too dry, or if a wooden or concrete floor is used, the area around the box should be sprayed with a hose or watering can. Clean dirt should be put at the bottom of each nesting com-

partment, and brought up to a level of a few inches above the outside ground so that no rain may wash in and spoil the eggs. The dirt should be given a basin-shape, thoroughly tamped until it has a smooth, firm surface. The slope should be sufficient so that the eggs will naturally roll towards the center, but should not be so steep that they will be broken when the hen gets on the eggs and pushes them apart.

A lining of fine hay or dried grass should be placed on top of the dirt. This should be thick enough so that it measures about one-quarter of an inch after it has settled. It should be built up well on all sides so as to cover the dirt completely, and no holes should be left in the corners into which the young



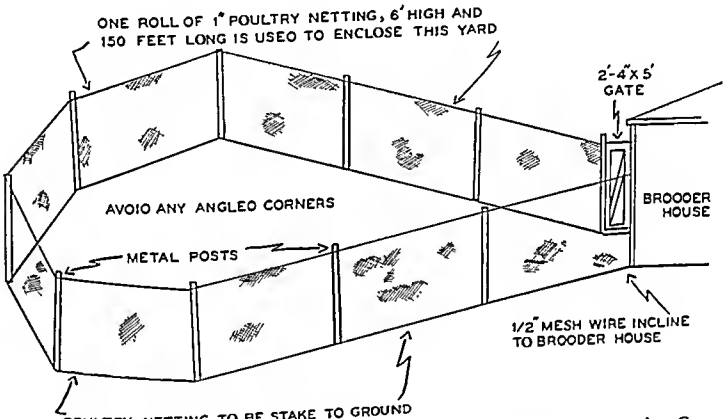
Rearing coop and "V" boards. Courtesy of Pennsylvania Conservation Commission.

chicks may fall. A flat of sod about 15 inches square and four inches deep may be inverted and used for the nest floor.

After the broody hen has been selected and thoroughly dusted, she may be placed on a nest with a few dummy eggs. This is best done at night. After one or two days, if the hen has settled down on the nest, the dummy eggs may be gently removed (also at night) and replaced with upland game bird eggs. The setting hen must be handled gently. The breeder must learn not to make quick movements; he must talk to the bird in a low voice until she becomes accustomed to him and his voice. The hen will usually arrange the eggs as he places them under her. Where more than one clutch of eggs are being set, they should be put under the hens at the same time. This will bring the hatches off together, with considerable saving in labor and equip-

ment, and will provide chicks of uniform size and age. The setting hen should be taken off the nest at a regular time each morning to be watered and fed. In handling the hen the breeder should slide the right hand under her breast, use the other hand around her wing, and lift gently. Care must be taken that there are no eggs held between her thigh and body or under the wings.

Almost any mixture of scratch feed containing wheat and corn may be used to feed the brooding hen. Clean, fresh water, charcoal and grit should also be provided. The hen must not be kept off the nest more than ten minutes the first few days, and never for more than 25 minutes after that. As the incubation period approaches, the time off the nest should be reduced. From the

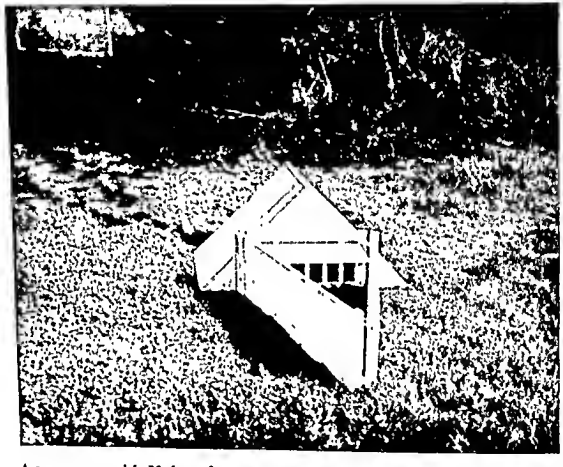


Temporary run for pheasant brooder house. Courtesy of Pennsylvania Conservation Commission.

21st day until they begin to pip, the eggs should be sprinkled daily with lukewarm water while the hen is off the nest. In extremely dry weather, the eggs may be sprinkled two or three times prior to the 21st day; that is on the fifth, tenth and 15th days.

Usually the hen will be anxious to return to her nest each morning as the hatching time approaches. Broken eggs should be removed from the nest each day, and soiled eggs wiped off gently with lukewarm water. If the nest becomes soiled in any way, soiled parts should be removed and fresh material substituted. Where hatching boxes are set outdoors, a feeding coop should be provided in which the hen may be placed each day. This may be a wooden frame or a wire fence just large enough for the hen to feed and move about. This pen should be cleaned after the hens are put back on the nests.

In the natural system of brooding, hens require from 23 to 24 days, and sometimes a little longer, to hatch. The first small break made in the egg by the chick is called *pipping*, and this begins on the 22nd or 23rd day. The hatch is usually finished within 36 hours after pipping begins, and during this period the hen should not be disturbed. She must not be removed or fed until the young chicks have hatched and dried off, and the mother and brood are ready for rearing. Chicks should be fluffy and dry before removal. The chicks will not all hatch together, but the shells from the earlier birds should not be removed, since these prevent the hen from resting too heavily



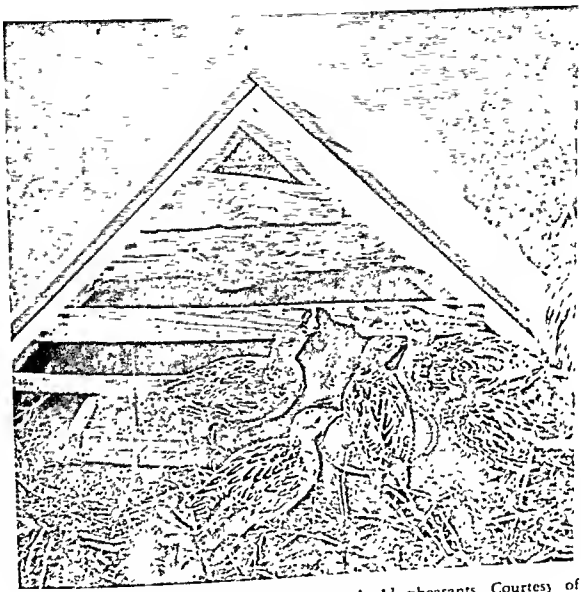
A-type coop with V-shaped run attached. Courtesy of Wisconsin Conservation Commission.

on the newborn chicks. After the hatch is completed, the hen may be given a generous feeding and watering. After hatching, the nest and all the nesting material should be cleaned out, and removed or burned. The setting box should then be sprayed inside and out with a strong disinfectant.

After the chicks are hatched, they should be removed during the warm part of the day, and placed in a bushel basket, the bottom of which has been covered with some soft material such as excelsior or burlap. The hen, which has been well-fed by this time (to prevent her scratching vigorously in search of food and thereby injuring the young chicks) should now be placed in a rearing coop, with one or two chicks put under her until she quiets down. Then the rest of the hatch are put in and the hen is left undisturbed for about

15 minutes. After that the coop should be revisited to see if everything is in good order. At night, the coop should be checked to see if all the chicks are under the hen. If not, they should be put under her, very quietly and gently.

There are many types of rearing coops used. Shed-roofed or A-type roofs are common. A coop should be about 36 inches long, 20 inches wide, and 24 inches high. The top and sides should be waterproof. Bars spaced three and



A-type of brooder coop housing eight-week-old pheasants. Courtesy of Wisconsin Conservation Commission.

a half inches apart permit the chicks to get out, but at the same time confine the hen to the coop.

A coop should be placed on a well-drained level spot, with a six-foot area around it cleared of high grass and weeds so that the young chicks will not be lost in a jungle. To prevent the hen from scratching, a burlap bag may be spread under the coop. In wet weather a piece of tar paper under the burlap will keep the chicks warm and dry.

For the first few days, the chicks should not be allowed to range very far outside. A guard should be erected close to the rearing coop, and inside of this water and feed provided, just as in artificial brooders. At night the

breeder must see to it that the chicks return to the hen. After a few days the guard may be extended to include a wider ranging area. After the fourth or fifth week, depending upon the weather, the brood hen should be removed, but the chicks should continue to be confined or restricted to a small range until they are at least eight weeks old.

In place of a guard, the breeder may decide to attach a small run to the rearing coop. Two boards about three feet long and one foot high are attached at each end of the coop and joined together in front of the coop in the form of a V.

7

The Nutrition and Feeding of Game Birds

THERE ARE PROBABLY AS MANY DIFFERENT SYSTEMS OF FEEDING GAME birds as there are game bird breeders. The great variation of feeding stuffs found by the birds in a state of nature can only be approximated in the diets of birds raised in a state of captivity. Long experience with domestic fowl has given us some general ideas of what can be fed to game birds. One thing is definite: game bird chicks require a much higher percentage of proteins in their diet than do domestic fowl chicks. On this most game breeders are agreed and the fact has been established by many experiments. Beyond this each breeder has his favorite method and, of course, these methods vary again with the different kinds of birds raised.

In order to understand fully the basis of feeding there should be some knowledge of the physiology of game birds and a fundamental understanding of the function of nutrients. Familiarity with the feeding habits of game birds in the wild is of value, even though we can't hope to duplicate the opportunities for such feeding.

Mr. Ralph B. Nestler, Associate Biologist of the Bureau of Biological Survey, has written for the 1939 YEAR BOOK of the United States Department of Agriculture ("Food and Life"), a comprehensive article on "The Feeding Requirements of Gallinaceous Upland Game Birds," and the rest of this chapter is completely based on that article. Thanks are herewith given to Mr. Nestler for permission to use his material.

Like barnyard chickens, upland game birds are gallinaceous fowls. Characteristically they are heavy-bodied birds in comparison with their short wings, and are, therefore, poorly adapted for long sustained flights. The legs are adapted for running and for scratching the ground, where most of their food, which consists of seeds and worms, is found. The course of food through

the digestive system of gallinaceous birds is as follows: after being swallowed with the assistance of the tongue, the food is forced through the system by means of muscles that line the digestive tract. If the bird has been without food for several hours, the first few mouthfuls go directly to the gizzard, the grinding organ of the body, within a few seconds. If, however, the fowl has been feeding more or less continuously, additional food will be stored in the crop until the gizzard is emptied of part of its contents. As the food passes from the storage pouch of the gizzard, it pauses for a short time in the stomach. The contractions and relaxations of the gizzard exert sufficient pressure to grind the food to a fine mass, which passes to the small intestine. There it is thoroughly mixed and brought in contact with the walls of the intestine. It then passes to the large intestine. Two blind pouches called ceca are located at the junction of the small and large intestines, and open up into the tract. These pouches rhythmically expand and contract, and thus receive and eject the intestinal contents. The remaining material, which is now in a semi-liquid condition, passes through the large intestine to the cloaca where portions of it are expelled at intervals.

Digestion pursues an extremely rapid course in the domestic fowl. In the short space of one and a half to two hours after the feed leaves the crop, an individual portion may be digested and the indigestible residue voided; but for complete digestion of a full meal the average time is about 14 hours. Nutritional differences exist, however. Just as turkey poults require different rearing diets because their growth is more rapid than that of the ordinary baby chicks, so there are differences among game birds in the type of natural food selected by the various species. The ruffed grouse, for instance, feeds almost entirely on browse (leaves, buds, and tender shoots) and berries, whereas the California quail and wild turkey subsist mainly on seeds, grains, mast and insects. Much work has been done by the Bureau of Biological Survey and the several state game commissions to determine of what the natural selection of foodstuffs of game birds in the wild consists. As a result, the following information has been obtained: seven types of food material are utilized by upland game birds as determined by post-mortem examinations of the intestinal tract. (1) Weed seeds—with the exception of the ruffed grouse and the prairie chicken, game birds eat very large quantities of miscellaneous seeds, many of them from obnoxious weeds. Seeds of beggarweed, bush clover, Japan clover, butterfly pea, ragweed, pigweed, sheep-sorrel, cartridge pea, foxtail, smartweed, black bindweed, and lamb's quarters are some of those found. (2) Animal food.—Grasshoppers, crickets, locusts, weevils, beetles, ants, flies, bees, earthworms and snails. (3) Seeds of cultivated plants.—Grains: wheat, barley, oats, buckwheat, benne, corn, kafir, millet, sorghum, rice and rye. Legumes: soybeans and cowpeas. (4) Mast.—Seeds of the pine, oak, sweetgum, maple, and ash. (5) Browse—(used

especially by the grouse). Leaves of chick-weed, field sorrel, Christmas fern, spruce, clover, woodsorrel, hawkweed, and mountain laurel; twigs and buds of maple, mountain-ash, hazelnut, apple, cherry, aspen, birch, American hornbeam, Eastern hophornbeam. (6) Fruit.—Blackberry, partridgeberry, smilax, grape, sumac, black cherry, dewberry and red mulberry. (7) Mineral.—Limestone pebbles, bits of oyster shell, particles of sandstone, and quartz pebbles.

The food selection by individuals of a species may vary considerably from that of the species as a whole. Mr. Leon Kelso, an investigator who analyzed the crop contents of Hungarian partridges, found that 40 per cent of the diet of one bird consisted of grasshoppers, where 85 per cent of the diet of another was composed of coulee crickets.

The nature of the flora on the local feeding ground also influences the diet. In areas where there are large raspberry thickets, pheasants feed extensively on these fruits. Likewise, in the vicinity of a pine grove, bobwhites will gorge themselves on the pine mast.

Availability of the natural foods also has a marked influence on the food habits of birds. Drought, heavy snowstorms, and other weather conditions may have such an adverse effect on the supply of certain favored food material that the game may be forced to alter their diet radically. During a very severe winter pheasants have been found with their crops stuffed with sumac berries, undoubtedly because of the scarcity of more desirable and more nutritive food material. During the course of a year, animal food constitutes only one sixth of the bobwhite's diet, one ninth of the ruffed grouse's and the ring-necked pheasant's diets, and 1/33 of the California quail's diet. Game chicks are omnivorous; animal food predominates in their diet, especially during the first few weeks after hatching. Young California quail during the first week of life eat animal matter to the extent of 50 to 75 per cent of their food, but after they are four weeks old, they take little if any more animal food than adult birds. The diet of any species shows great variation from month to month. When insects are plentiful, during the summer, the proportion of animal matter in the diet increases; grain consumption is greater during the harvest season; weed seeds are a major article of diet during the late fall; and winter brings an increased consumption of nuts.

Thousands of farms throughout the country are without sufficient food and cover to hold and support a good population of upland game birds throughout the winter months. Even when wild foodstuffs are in abundance during late winter, the supply may be exhausted or made inaccessible by ice and snow. Wild life faces starvation unless it can leave such localities for sections where food is obtainable. Bobwhites are far less resistant to starvation than pheasants, and cannot be deprived of substantial food for more than a few

days at a time without danger. Heavy mortality may follow a food crisis that lasts as long as a week, and populations of wide areas may be practically annihilated when shortages last two weeks. Farmers who do not want to see the game depleted on their farms must provide food on the home range during the periods of shortage, by planting food patches, and by establishing feeding stations during emergency periods. If there is land on the farm that is unsuitable for cultivation, natural vegetation should be allowed to grow, and cover and food should be supplied to the game. A farmer can assist nature by planting grasses, legumes, trees, shrubs and vines on these places. Phenomenal results have been obtained in the South by planting *bicolor lespedeza.* This is a new plant for native quail, and they have shown an enormous predilection for it. Most state game commissions can be called upon for advice concerning the proper planting for given localities. In regions experiencing severe winter weather, wheat, oats, barley or buckwheat are not very effective as winter food, as they have weak stalks incapable of holding the head of grain above the ice or snow. Mr. R. G. Hill of Michigan points out that "a small patch of corn planted adjacent to permanent winter cover or near a patch of rye or sweet-clover seems to fulfill the winter requirements of most of our wildlife species which occur on the farm. An early maturing variety of yellow dent corn, such as Golden Glow, may be planted and cultivated at least two or three times, or a sufficient number of times to insure a good crop of ears. The crop should be planted and cared for the same as the regular crop grown for grain production. If cover is limited in the vicinity of the food patch, it is well to omit the last cultivation and allow weeds to grow and form a dense mat of ground cover."

Corn is also resistant to shattering and there is evidence to prove that it is the most palatable of the grains.

Shelters and Feed Stations

Permanent shelters where grain can be placed make good winter feeding stations for game birds. These shelters should be built close to protective cover in areas protected from drifting snow, sleet and wind. Sufficient openings should be left so that the birds can escape easily from predators. Stations should be started early in November, or not later than the first of December, so that birds will learn where they are located; establish them within their regular daily feeding range. An attendant should visit them regularly and stock them with adequate supplies of grain. A few corn shucks provide the simplest yet probably the best type of station which can be established. Where bobwhite or Hungarian partridge are abundant, one feeding station to every 40 acres is desirable. For ring-necked pheasants, one effective station per square mile is satisfactory. Wild turkeys should be provided for in all the

winter headquarters they are known to frequent, and feeding stations should be set up at the rate of one every five or ten square miles for prairie chickens. Very little can be done for ruffed grouse in the way of emergency feeding. In the wild, this species subsists primarily on browse and fruits, and although they will relish grain in captivity, they are slow in learning to accept this diet in the wild.

It has been estimated that the approximate quantity of grain needed to maintain one game bird a week in severe winter weather, in addition to the wild food that may be picked up, is as follows: pheasants, two pounds; prairie chickens, one pound; Hungarian partridge, three-fourths pound; quail, half a pound. In emergencies, feeding may be done wherever birds are found, including ditches, hard-packed roads, haystacks or any natural windbreak or shelter. The important thing is that the feed be placed where the birds will find it.

NUTRITIONAL REQUIREMENTS OF GAME BIRDS

Water

Game birds in the wild state manage well on dewdrops and succulent material but in confinement they require a constant supply of water. Approximately 56 per cent of a chicken's body and 72.5 per cent of the egg contents is water. It is fair to assume that these percentages approximate those in the various types of game birds and their eggs.

Water ranks far above any other substance in the rate of turnover in the body. It serves to soften the feed, aids in the processes of digestion and absorption of other nutrients, serves in transporting the end products of digestion from the digestive tract to various parts of the body, and assists in the elimination of waste products. Water also facilitates cell reactions, helps to regulate body temperature, aids in the lubrication of the joints, and acts as a water cushion for the nervous system.

Seeds

Seeds and their by-products have a very important place in the diet of game birds. For the feeding of birds in confinement, cereals are used because of their availability instead of most of the seeds obtained by birds in the wild. This feed material is considered valuable primarily because its carbohydrate content supplies the fuel for the body heat and is the principal source of energy. The grains also add bulkiness to the diet. There is some evidence that the presence of a small quantity of indigestible and somewhat bulky material in the intestines facilitates both the digestion and absorption of the digestible portion.

Cereal grains and their by-products are the chief sources of Vitamin B_1 (thiamin) and Vitamin E in a typical diet for birds. Vitamin B_1 is essential for growth, maintenance of appetite, and the prevention of polyneuritis; vitamin E is vital for the production and hatchability of eggs. Certain cereal by-products, such as rice, bran and wheat middlings, have also been found comparatively high in manganese, which is very necessary in the prevention of perosis or slipped tendon. Yellow corn is prized as a fair source of Vitamin A. Titus has pointed out that oats and their by-products are a good source of anti-gizzard-erosion factor; they tend to prevent rancidity when finely ground and thus are valuable in the preservation of Vitamins A and E; there is good indication that they tend to prevent a fishy flavor in a bird's flesh when cod-liver oil is fed; and they help prevent cannibalism, toe picking, and feather picking. Norris, working with pheasants, found that wheat flour middlings when used as a large portion of the diet had definite perosis-preventive properties, and promoted fair growth and good feathering. Hawkins, Moor and Leopold found game birds like corn better than any other grain. The percentage of other seeds consumed by the time the corn was exhausted gives a good idea of how feeds compare in palatability:

	Per cent		*Per cent*
Wheat and scratch feed	50	Sweet corn and Sudan grass seed	35
Buckwheat	45	Sorghum seed	25
White corn, popcorn and barley	40	Soybeans, oats and rye	15

Protein Concentrates

Proteins are indispensable constituents of the blood, muscles, organs, skin, tendons, bone, and feathers—in fact, of all tissues of the animal body. They constitute about one-fifth of the live weight of a chicken and between one-eighth and one-seventh of the whole egg. Although some protein is derived from the cereals and green foods, the primary source is protein concentrates. There are two classes of these concentrates, namely, those obtained from animal sources, such as dried skim milk, meat meal, and fish meal, and those obtained from plant sources, such as soybean meal, linseed meal, and peanut meal.

Callenbach, Murphy and Hiller have pointed out that better growth of pheasants is obtained on a diet containing a higher level of protein than is suitable for the domestic chick. The best growth and feathering and the greatest feed consumption per 100 pheasants were secured through the use of a diet analyzing approximately 28 per cent of protein.

Norris and associates of Cornell University, in cooperation with Bump of the New York State Department of Conservation, compared the effects on

pheasants of diets containing the following proportions of protein—18, 21, 24, 27, 30 and 33 per cent. The chicks were started on the diets approximately 24 hours after hatching and the experiment was continued for 18 weeks. After three different experiments it was concluded that a diet containing 24 per cent of protein is necessary for the rapid early growth of pheasants. This is about four per cent more than the requirements of chickens. The maximum growth of pheasants was attained at 27 per cent, while levels of 15 and 18 per cent significantly retarded growth; cannibalism, and feather pulling were also more prevalent at these low-protein levels.

In his study on the protein requirements of bobwhite chicks, Norris in New York used protein levels of 21, 24, 27, 30, 33 and 36 per cent on battery-reared birds. Two experiments showed that the bobwhite requires 27 per cent of protein in its diet for rapid growth. However, the difference between results at the 24 per cent and the 27 per cent level was not great.

Vitamins

Vitamin A

Vitamin A is essential for growth, reproduction, hatchability, and maintenance of health. It is found chiefly in materials of animal origin, such as the livers of both mammals and fish, and in fish body oils. Cod-liver oil when properly prepared and stored is a rich source of this factor. Sardine oil contains about 13.5 per cent as much of this vitamin as cod-liver oil.

Plant materials are the chief sources of Vitamin A precursors—the substances that are changed to Vitamin A in the animal body, of which carotene is the most common. Such green foods as fresh alfalfa, kale, and clover are excellent carriers. If alfalfa or clover is properly dried and stored, it retains a great deal of carotene.

Oxidation and heat readily destroy both Vitamin A and its precursors. Because of this fact, cod-liver oil should be kept in closed, well-filled receptacles in a cool place, and should not be mixed with feed until a short time before it is used. Corn and alfalfa products lose 50 per cent or more of the carotene when stored for one year.

Vitamin B_1 (Thiamin)

Ordinary grains contain sufficient quantities of Vitamin B_1 for animal maintenance and growth.

Vitamin D

Vitamin D is required for the development of a normal skeletnn and fnr reproduction. For animals living in the open, this vitamin is manufactured

in the body by the action of the ultra-violet rays of the sun upon certain Vitamin D precursors, such as cholesterol and ergosterol, present in the system. But when birds are raised and maintained under artificial conditions another source of this factor must be used. Cod-liver and sardine oils are the best sources.

Vitamin E

Vitamin E is necessary for the reproduction and hatchability of eggs. Green foods, such as alfalfa and clover, and the germs of grains are sources of this factor. Since Vitamin E is quickly destroyed by rancidity, feeds that are even slightly rancid should never be used.

Vitamin G (Riboflavin)

Vitamin G is another factor essential for growth and for hatchability of eggs. Dried whey, yeast and dried skimmed milk, and liver are especially rich in it, and green foods are very good sources. Alfalfa leaf meal from plants that have been properly harvested and cured contains more of this factor than green alfalfa. Proteins concentrated from animal products are fair sources, but grains contain very little.

Other Vitamins

Not enough research has been done on Vitamin C and other less known vitamins to determine their requirements in game bird feeding.

Minerals

Calcium, phosphorus, manganese, sodium, potassium, magnesium, sulphur, chlorine, iron, iodine, copper, zinc, and silicon are all known to be necessary for the maintenance of life and reproduction, and possibly cobalt should be included in this list. Many of these elements are found in ordinary foodstuffs in adequate quantities to meet the animal's needs. However, there are certain ones, such as sodium, chlorine, calcium, phosphorus and manganese, that may have to be supplied as supplementary material.

Sodium and Chlorine

Sodium is very necessary for the maintenance of the acid-base equilibrium of the body, and chlorine is an important constituent of the digestive juices. As a rule, both may be furnished through the medium of common salt. For the domestic fowl 0.5 per cent of salt in the chick diet and 0.7 per cent in the mature stock has usually been found sufficient.

Calcium and Phosphorus

Calcium is one of the main elements involved in skeletal and egg shell formation. It may be furnished to birds in the form of high grade limestone, oystershell, or crabshell, all of which are good sources. Phosphorus works together with calcium in the metabolic processes of the body. It, too, is a characteristic constituent of the bones. An excess of either or both of these elements is to be avoided, since it has been found that an excess of inorganic phosphorus will considerably increase the incidence of perosis in domestic chicks. Usually for growing birds there is sufficient phosphorus in the diet without any being added, but for laying stock it is sometimes necessary to supply extra phosphorus. When calcium and phosphorus are both required, steamed bonemeal is fed as part of the diet.

Callenbach and Murphy of Pennsylvania State College found that for pheasants reared in batteries a diet containing 1.5 per cent of calcium and 0.75 per cent of phosphorus gives satisfactory growth and sound bone development.

Manganese

Manganese deficiency and perosis (slipped tendon) are definitely linked together. Although perosis is apparently the result of a complexity of factors, the addition of manganese to a perosis-producing diet will decrease the malady considerably, if not eliminate it entirely, especially if the percentage of phosphorus is kept at a low level. According to various experimenters, 40 to 100 parts per million of manganese in the diet will prevent perosis. Two and one-half pounds of manganous sulphate are mixed with 100 pounds of common salt, which is in turn mixed with the diet in the proportion of 0.5 per cent of the mash mixture.

Other Minerals

The value of the addition of other minerals to the diet is doubtful. The addition of sulphur to the diet may be of use in combating coccidiosis, an avian disease affecting the digestive tract, especially the ceca. However, sulphur has little nutritional value.

Grit

Work by nutrition workers has shown that gallinaceous birds can live without grit and even digest whole grain without its aid. When grit is present, however, there is more efficient utilization of feed, and less energy is required

by the gizzard for grinding feed. In the case of growing domestic chickens abscesses may occur in the gizzard lining if a finely ground, low fiber diet is fed without grit. Leopold has pointed out that most game birds in the wild consume grit daily, pheasants particularly frequenting graveled roads at nightfall, presumably for this purpose. For chicks which do not have access to soil it is important that the right kind of gravel be supplied. Any insoluble, nonfriable rock material may be used. Fine sand is of no use as grit because it readily passes through the gizzard, but very coarse sand may be used for young birds. Domestic chick grit and adult grit may be used for game birds. It is purchased at poultry feed stores and is kept in separate hoppers before the birds at all times.

Feeding Practices

There have been two notable changes in the management practices of propagators of upland game birds: (1) From rearing and maintaining the birds on the ground to rearing and maintaining them on wire cloth with the exception of pheasants in most cases; (2) from custard-clabber feeding of game chicks to a more simple and sanitary system of feeding dry mash. However, some breeders still successfully raise quail on the ground, especially where the soil is light and sandy. A beginner would be better off trying to raise game birds on wire as there is less danger of disease. In such cases, fresh-cut green feed taken from nearby grass plots or a suspended cabbage or lettuce head should be supplied to the confined chicks.

The making of clabber is a laborious, unnecessary procedure and is apt to bring about parasitic infestation of birds by drawing hundreds of flies which are carriers of disease germs.

Feeding Pheasant Chicks

The procedure that is used successfully on the Fisher State Game Farm in Pennsylvania is as follows:

The chicks are fed the first three days on a 30 per cent protein pheasant starting mash, with a little fine sand mixed in and water. At six and ten a.m., and at two and six p.m., they are fed sparingly on fine-grated hard-boiled egg sprinkled on mash, to teach them to pick the mash. Three times daily they are given fine chopped greens. On the fifth day, they add fine grit, oystershell, and charcoal. At three weeks they are started on fine chick grain mixed with mash, and at five weeks intermediate scratch is given. Starting the seventh week, they begin feeding a high grade growing mash in rain-proof hoppers. In addition, a medium scratch grain is fed every evening. On this ration birds are raised to maturity.

Feeding Bobwhite Quail Chicks

For bobwhite raising, Coleman recommends that one or two hours after the bobwhite chicks are placed in the brooder they should be given dry quail mash in hoppers or small trays, clean coarse sand, fresh tender greens, and water. The water used for the first few days is drawn several hours before using and allowed to warm to room temperature to prevent chilling the quail.

The greens (lettuce, alfalfa, or clover), should be fed at least three times daily from the first day. They are cut fine with scissors and sprinkled in the water and in the sand tray until the birds are about four weeks old, when they are old enough to pick at larger greens. On the fifth day from hatching add a little pulverized oystershell and baby chick-sized charcoal in the sand tray, mixing them with sand. Several days later add baby chick-sized oystershell. Coleman, whose White Oak Quail Farm in Virginia is one of the most famous, does not feed any tomatoes, cucumbers, apples or carrots, having found them of little value in the diet of either young or mature quail that receive a balanced diet supplemented with fresh greens.

At the fifth week, Coleman feeds a chick grain seed mixture, consisting of wheat, kafir corn, rolled oats, cowpeas, soybeans and millet sparingly in the afternoon, so that the birds will be forced to eat considerably more mash than grain every day. When the birds are ten weeks old, they are started on a grain seed mixture suitable for mature bobwhites. During the laying period Coleman believes that it is very important to control the amount of grain-seed mixture given so that the quail are forced to eat mash freely. The egg producing ingredients are in the mash and it is desirable that the birds eat as much of it as possible. In severe winter weather feed more grain seed mixture than mash, but keep the mash before the birds at all times, for all ages, from the very first feeding.

Consistency of Mash

The practice of feeding wet mash is rapidly becoming obsolete. It requires extra time and labor and is messy, unsanitary and unnecessary. Unless fresh batches only are kept before the birds and the receptacles are cleaned every day, there is great danger of the birds eating sour contaminated feed that will be very injurious.

Many breeders use a finely ground meal so that each mouthful of feed will contain all the ingredients of a balanced diet. However, birds prefer discernible particles, and moreover the powdery feed irritates the birds' nostrils, often caking there, and consequently may lead to nose picking and cannibalism by other birds.

Feed pellets have become popular because they eliminate the bad features

of both powdery and coarsely ground feed. No studies have thus far been made on the advantages of feeding pellets to game birds and in experiments in this type of feeding of domestic fowl and turkeys the results have not been conclusive.

Cafeteria Feeding

Cafeteria feeding means supplying individual ingredients of a mash in separate sections of a hopper and permitting the birds to balance their own rations.

The value of "cafeteria" choice feeding of pheasants has not given satisfactory results as measured by growth, feather development or livability, but more experimentation is necessary. It has worked well with domestic poultry. In this system, it is necessary to supply somewhat more feeding space per bird than for ordinary grain and mash feed.

Feeding Formulas for Game Birds

It will hardly pay the average small breeder to make up his own rations. Many commercial feed companies sell completely mixed feeds which are based on experiment station formulas and these have proven satisfactory to most commercial breeders.

The author's own experience with geese raising during war time was as follows. The geese were put on green pasture. A growing ration for chickens was fed. Then there was a shortage of chicken mash and I fed them on a hog ration. Then the hog ration ran short and I used a dairy ration. I could not discern any difference in the rate of growth according to the mash fed. Actually, when the range was good, the geese ate very little grain and relied chiefly on pasturage.

This same experience was repeated in the feeding of hens. The so-called laying mash grew scarce and I fed my layers first hog feed and then dairy feed. Egg laying continued at the same rate no matter which mixture was fed. The dairy feed contained 18 per cent protein and was much cheaper than the laying mash. Personally I believe that all rations for different kinds of poultry or game birds are concocted in a highly theoretical manner and are what men think birds should eat. Conceding that it has been conclusively proven that game bird chicks require feeds with a higher protein content than domestic fowl chicks, all the permutations and combinations used in giving fowl the proper diet are largely the results of limited experiments, which, although carried out in many places, and on a large scale, do not finally prove anything. The most famous vegetarian in the world, George Bernard Shaw, is a nonagenarian. Does that prove that meat-eaters are at a disadvantage? Under natural conditions game birds choose a vast variety of foods. Somehow, with-

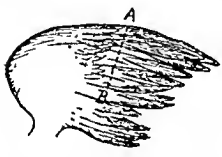
out a knowledge of balanced rations, they survive. The new idea in poultry and hog feeding is the so-called cafeteria style. Food of various sorts is put into a hopper in subdivisions, and the fowl or hogs permitted to choose their own proportions of any particular kind of feed. This has worked satisfactorily for hogs, and Louis Bromfield reports in his book, MALABAR FARM, that laying hens fed this way produced 600 eggs a day in a flock of 700 birds. And that's quite a record!

8

Wing Clipping, Pinioning, Brailing, etc.

WHERE UPLAND GAME BIRDS AND WILD WATERFOWL ARE NOT CONtained by covered yards, wing clipping is resorted to, in order to unbalance the bird, and thus prevent his flying. Several clippings are necessary as the wing feathers grow back in time. The principal flight feathers or primaries of one wing are cut well away from the flesh, with a sharp pair of scissors.

Another means of unbalancing the bird is to pull the stub feathers. A landing net is used to catch the birds. Try to get the birds to fly into the net rather than go after them as one might do to catch butterflies. To take them out of the net grasp by both legs to avoid injury to the birds. Holding the bird with its head toward you and spreading the wings with the thumb and first finger of the same hand, use a pair of pliers or your fingers to pull the stub feathers out. Pull upwards. Avoid pulling the blue or blood feathers as this may induce bleeding and encourage cannibalism. Blue or blood feathers grow more rapidly than others.

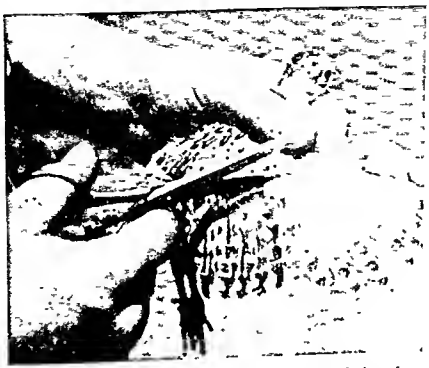


Sketch of wing. Main flight feathers to be cut along line from A to B. Courtesy of Wisconsin Conservation Commission.

Pinioning

Pinioning, as recommended by the Fish and Wildlife Service, is practiced where it is intended to prevent the bird from ever flying again. It is practiced almost entirely on breeders. Adult birds are pinioned by raising the outermost portion of one wing and cutting off the last section. First, a cord is tied tightly at a point slightly over the point of amputation. Strong pruning shears or scissors, or

a sharp knife, driven by a mallet, are used to clip off the joint close below the cord. A pinch of tannic acid in powdered form is pressed firmly into the wound to stop bleeding. The cord should be removed a few days later when the wound is healing. Pinioning should be done well in advance of the breeding season, as the shock is apt to affect mating. It is better to pinion young birds as the shock is less severe. Ducklings and goslings are best pinioned when they are a week or ten days old. Pheasants, quail and partridges are very seldom pinioned. The Peytons of Duluth, Minnesota, use heavy tin-snips for pinioning and have not found it necessary to tie off the last joint even

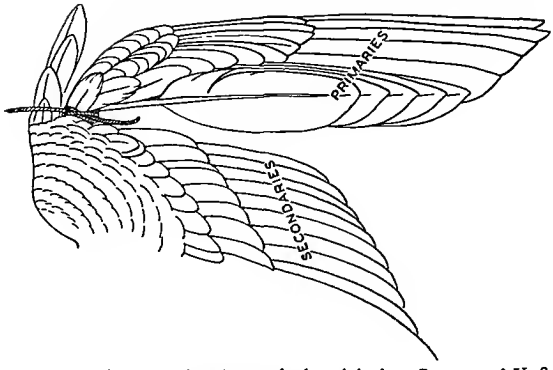


Young pheasants in open pens must have their wings clipped. Note position in which bird is held. Courtesy of Wisconsin Conservation Commisssion.

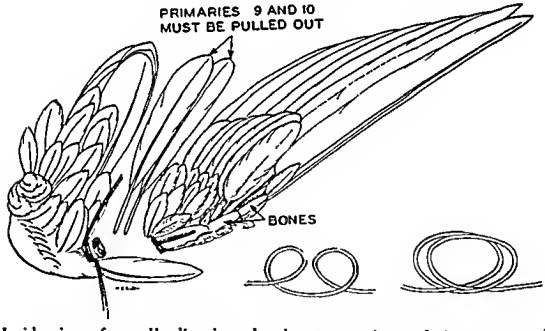
in the case of adult birds as there is very little bleeding when sharp tools are used.

The Michigan Agricultural Station recommends tenotomy as a method of preventing flight. The main wing tendon, which passes over the outer edge of the last joint of the wing, is severed by flexing the wing and burning through the skin and tendon with an electric burning needle. When the tendon is cut it will snap apart. Only one wing need be treated to prevent flight, but when both wings are so treated flight is prevented but sailing is allowed. This is a form of limited flying. However, tenotomy should only be practiced on birds which are to be retained as breeders. It should not be done to birds which are to be released, as they will need full power of flight to survive in the wild.

The Peytons practice another method of tenotomy. The feathers on the upper side of one wing are plucked away, the skin slit with a sharp knife, and the extensor wing tendon is gripped with a small pair of round-nosed pliers or forceps. This big tendon can be felt through the skin of the wing. By moving



Top view of a mallard's wing ready for pinioning. Courtesy of U. S. Fish and Wildlife Service.



Inside view of a mallard's wing, showing amputation and tie. Amputated bones are exposed. Courtesy of U. S. Fish and Wildlife Service.

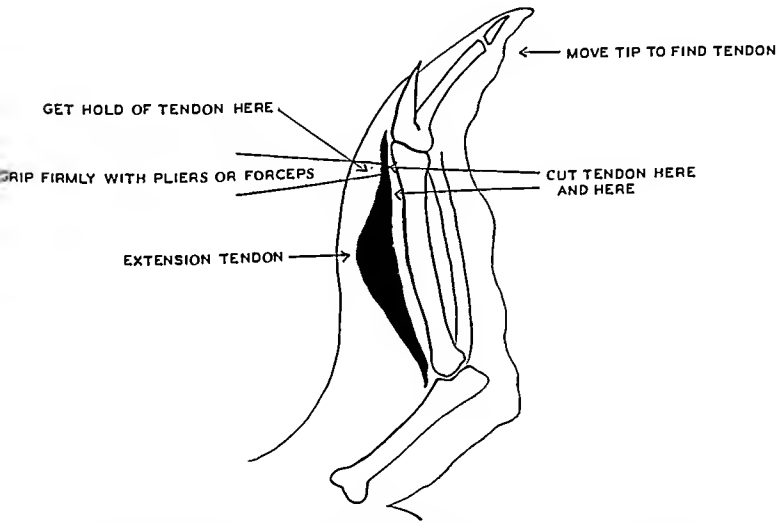
the wing-tip back and forth a number of times, the position of the tendon can easily be observed. A cut is made on both sides of the point held with the pliers. Taking out a piece rather than severing the tendon prevents it from growing together again. The cut should not be made too close to the joint, nor should any muscles be cut.

Brailing

The Wisconsin Conservation Department gives the following instructions for brailing pheasants.

A pheasant brail is a leather strap that measures approximately eight and one-half inches in length and one-half inch in width. One end of the brail is split. The brail is made of very soft leather so as not to injure the wing of the bird. Brails may be split down about one and one-half inches from one end. They may either be made or they may be purchased for approximately five cents each. It is not advisable to attempt to brail young pheasants because their wings are growing constantly.

Take the split ends of the brail and pass them around the shoulder of the



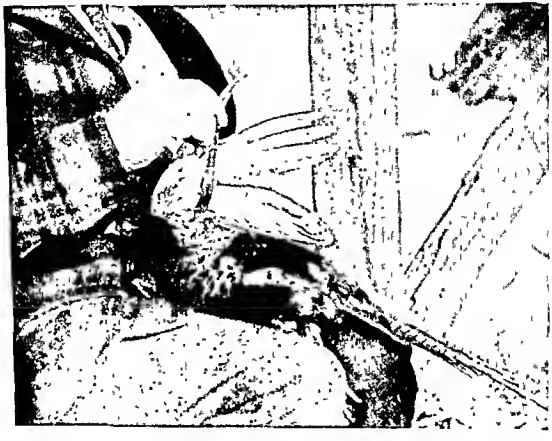
Top view of wing. The extensor tendon is actually white, but it is in black in this diagram to show its position in relation to the wing bones. Courtesy of J. L. Peyton, Duluth, Minn.

bird so that the ends meet at the top of the shoulder. Take the long end, A, and slip it between the first and second flight feathers, bringing it around to meet the split ends, B and C. Adjust brail to allow the wing about half play, but not enough for proper flight. Fasten the ends, A, B, and C, with a brass split pin with prongs facing out.

If birds are penned for a long period, brails must be changed from one wing to another, about every three weeks to one month. See illustrations, page 67.

Summary of Methods

The relative merits of the various methods of preventing flight differ according to the ultimate purpose for which the bird is intended. Game birds, such as pheasants, quail, partridge and mallards are usually shipped to poulterers, or the direct retail trade with full plumage on their bodies. Wing clipping is obviously not desirable in this type of marketing, as it spoils the

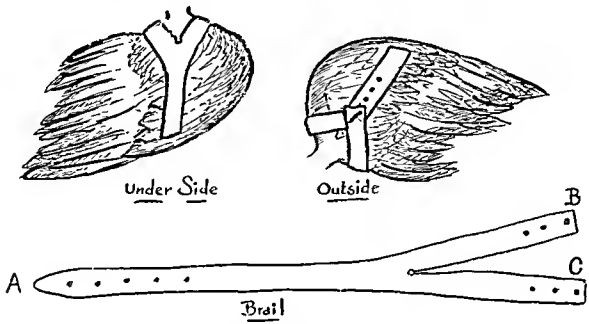


Putting on the brail. Courtesy of Wisconsin Conservation Commission.

appearance of the dead bird. When game birds are marketed completely dressed, with only the head feathers left on the body, this objection doesn't hold. Where birds are to be released for hunting in the same year in which they are hatched, wing clipping is also undesirable for Canada geese, as the feathers will not grow back fully enough in so short a time, to furnish good gamy hunting.

The ideal way to raise gamy birds with full plumage is in covered pens, and small units containing a limited number of birds are better than larger pens, where there is apt to be more fighting and feather pulling. Large covered pens are expensive because of the extra cost of the two-inch mesh poultry wire used for the cover. Smaller unit covered pens involve an additional expense for the posts and the peripheral fencing, but as prominent a breeder as Mr. Tom Rae advocates them, and keeps 50 pheasants in a pen 12½ by 12 feet.

If covered pens are not desired, brailing must be resorted to. This means considerable additional labor. It takes about six men a whole day to brail 1800 pheasants. Brails must be changed to the other wing after three or four weeks. The gaminess of brailed birds is a point of heated discussion among pheasant raisers. Many claim that no bird will provide good shooting if



Detail of brail. Courtesy of Wisconsin Conservation Commission.

strapped up on one side for any length of time. Others who practice this method, and sell their birds to hunting clubs and conservation commissions, aver that they have had no complaints on the score of gaminess from their customers.

Pinioning and tenotomy prevent all future flight and once these operations are performed, no further repetition of this job is required. Sometimes in the latter operation, the tendon grows together again, but this does not occur often. Tenotomy is a good method where the food market is the objective.

9

Predators and Their Control

FENCED-IN AREAS FOR UPLAND AND AQUATIC GAME BIRDS PROVIDE THE best method of keeping predators out. If the game birds are not pinioned or do not have their wings clipped, or are not brailed, it is necessary to use wire ceilings over the range yards. While this is an additional expense, it keeps out winged predators such as hawks and crows, and also raccoons, gray foxes, roving cats, opossums and squirrels.

In building fences a ditch from six inches to a foot deep and shovel wide should be dug around the perimeter of the enclosure. One-inch mesh poultry wire, three feet wide, should be lowered into the ditch, and bent over horizontally, extending outwardly from the fence for about six inches to one foot. Small notched sticks should be driven into the horizontal section of the wire. It is then covered with dirt as the ditch is filled up. On top of the two-foot high wire, a four, five or six-foot wire of two-inch mesh should be placed. Putting an electric single-strand fence around the wire fence at a height of about one and a half feet makes for additional protection against predators.

The RACCOON'S naked toes and sole are plainly imprinted. Five toes with claws on each foot. Hind feet are longer than front ones. Mature coon fore foot tracks measure 3¾ inches, hind feet about 4¼ inches.

The CAT'S claws do not register as he walks. Hind feet fit exactly into the tracks made by the fore feet.

The WEASEL'S tracks are ¾ in. in length, paired, and show only four toes of the five toes on each foot.

Like the cat's the FOX'S hind feet fit into the tracks of his fore feet, but, unlike the cat's, his claws make imprints. The toes are widely placed and small pad impressions are characteristic. Sometimes the fox's tail drags, leaving an impression between the footpriots.

The OPOSSUM'S tracks are like those of a miniature man walking on his hands. The imprints are about 1¾ in. in widtb, and sbow a well developed thumb on the hind foot. Both front and hind feet have five toes with claws on all except the thumb. Tbe trail seems to have been made with "gestures."

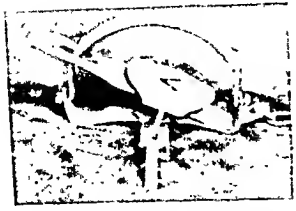
The SQUIRREL, whose hind legs are longer than his fore legs, always places the hind legs in front when in motion. The fore feet tracks of the squirrel are paired back of tbe hind feet tracks.

The COMMON SKUNK, like the raccoon, is a flat foot; his front claws register plainly, his hind ones scarcely at all. The diagonal position of the foot prints show a galloping skunk.

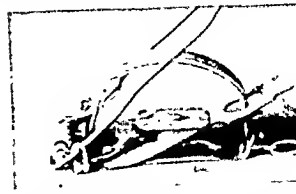
Tbe prints of the fore feet of the LITTLE SPOTTED SKUNK, like those of a squirrel, are almost evenly placed behind the hind feet. The skunk's fore foot tracks register all five toes, the squirrel's only four. The skunk's tracks are more stubby toed than a squirrel's.

The MINK'S tracks are usually found on mud banks near streams. Hind feet are 1½ to 2 in. Forefoot is rounder and 1 inch in length.

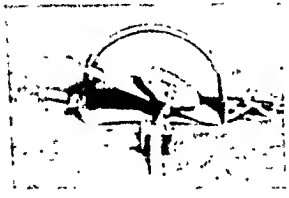
The COYOTE'S tracks are similar to those of a large fox. Footprint is 2½ inch long, distance between steps is about 16 inches.



No. 0 Victor trap for weasels and rats.



No. 1 Victor stop-loss with auxiliary guard with delayed action. For animals that twist or chew off trapped foot, such as skunk, mink, opossum, or raccoon.



No. 1½ Victor for skunks, mink, weasels, and opossum.

No. 2 Blake-Lamb trap, single spring, for fox.

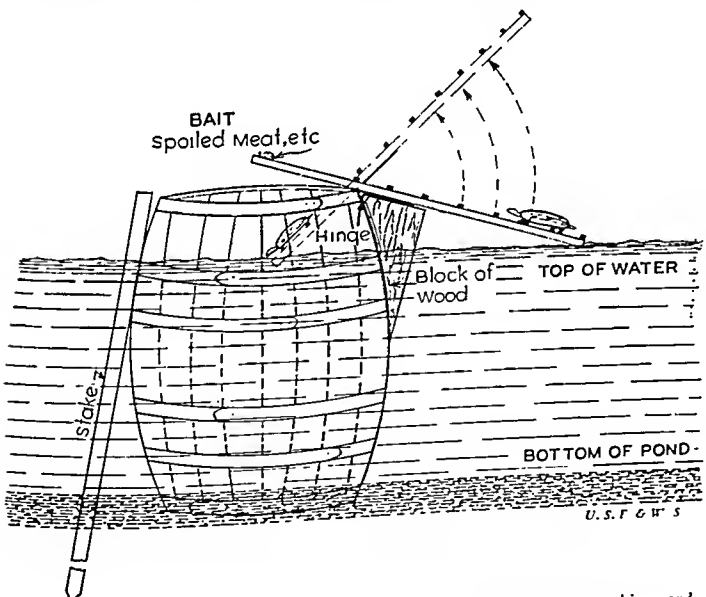
No. 2 Victor trap, chiefly for fox, but also used for raccoon and mink

A game breeder would do well to learn the tracks of ground predators, and provide himself with the proper kind of traps, and place these around the yards.

Mr. Harry Rodgers, a New York trapper, who has spent thirty years studying the habits of animals that prey on game birds and domestic poultry gives the following instructions for their capture:

Preparing the Trap

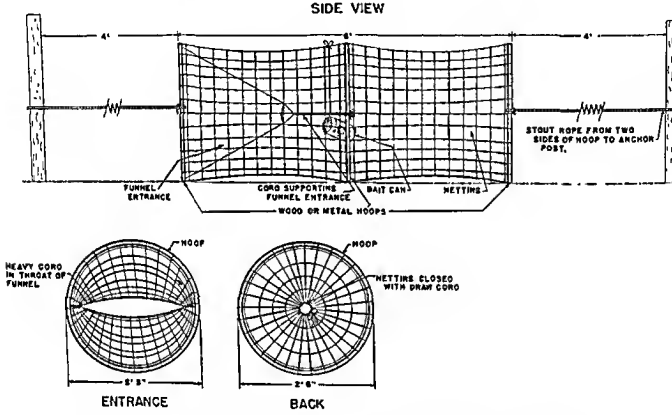
All new traps should be boiled in water for an hour or two until all the grease and oil on them rises to the surface. The oil is skimmed off the top and a coloring material such as soft maple bark, black walnut hulls or logwood chips are put into the solution, at the rate of a pound of any of these dyes to approximately 25 to 50 small-sized traps. The traps are lifted out occasionally with wire to see how the coloring takes. When the traps are coated with a good blue-black color they are ready to take out of the solution, and



Turtle trap. The board should be attached to the barrel by a free-working strap hinge and should be almost on a balance. Cleats on the tilting board make the trap more effective. Any ordinary water-tight barrel can be used. It can be staked down or weighted.

should be handled only with clean gloves, especially for the more elusive animals such as foxes, coyotes, and mink.

Traps are set on logs which cross streams, in animal dens, and along trails. Fairly fresh fish is the best all-around bait for most predators. Scents, purchased from trapping supply houses, have the advantage of attracting animals to your sets from a greater distance than bait alone. In baiting sets, bait is put a few inches in back of trap in such a manner that the animal, in trying to get the bait, will have to step into the trap. Dead brush can be placed on



A turtle trap made with netting. Courtesy of E. C. Addy, *Waterfowl Management in Small Areas,* Wildlife Management Institute.

both sides of trap to form a guide for animals to get to hait. Anything, such as a stone, stump or tree can be used as a guide. In addition to fish, all natural bait, such as rahbits, mice, and birds (not protected by law), can he used to attract predators to sets.

There are three types of scents or lures used in trappings: those that appeal to hunger, curiosity and passion. The passion lure is used mainly in the spring in the hreeding season. This type of scent is ohtained from the glands of the animal to he trapped and is usually taken from the animal while in heat, and preserved hy the makers of scents and lures. The hunger type of scent is made up of the natural foods that the animals would ordinarily eat. The curiosity type of scent is made up of various tinctures of unnatural odors to which the animal is not accustomed.

For hest results set traps only with clean gloved hands. Ruhher footwear, which permits frequent washing in nearhy streams, should always he worn

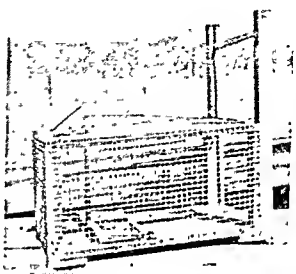
in trapping the more elusive animals. Gloves or rubber footwear are not necessary for trapping the more common animals, such as skunk, opossum and the smaller vermin.

In making sets for the more elusive animals, a piece of cloth or canvas about three feet square is used to stand or kneel on, and also serves the purpose of providing a place to rest the trapping outfit, which usually consists of a hatchet, pliers, wire, scent and bait. This cloth or canvas is always folded with the ground side in, so that it will not come in contact with any foreign scent.

When fox or coyote are caught in the trap, they should be killed in such a manner that no blood is shed on the set. The shedding of blood on the trap or set will arouse the suspicion of fox or coyote and they will not come near the set. A light blow struck across the bridge of the nose will paralyze them temporarily. A foot is then placed over the heart, pressing heavily toward the rear of the heart until the animal is dead. Death comes in a few minutes. The more common animals are killed by drowning, a blow over the head or shot with a .22 rifle.

The scent of an animal previously caught in the set attracts like species.

A suspicion-remover type of scent is made from the urine of animals confined in fox and mink farms. Professional trappers procure their own supply of animal urines by draining the bladders of trapped animals. A few drops of urine on a trap and about the set will allay the suspicions of the animals to be trapped and kill any foreign odors.



Evans vermin trap. This trap is 14 inches high, 17 inches wide, and 24 inches long. The front standards are 27 inches tall and contain a slot three-eighths of an inch wide and five-eighths of an inch deep. The door measures 15 by 12 inches. The edges of the door and treadle (6 inches wide) are soldered in folded strips of heavy zinc. Mesh is five-eighths of an inch square, heavily galvanized. All screws are brass, the spring phosphor-bronze, and the levers iron. The corner posts are tinned inside and the whole trap dipped in paint. The small triangle of tin on the far standard falls across the slot when the door is down and prevents it from being raised. Courtesy of U. S. Fish and Wildlife Service.

The woodchuck or ground hog, as has been stated, is not a predator, but his tunneling demands that he be brought under control. Using a steel trap No. 1 or 1½ is one way. Another is to block up one end of his burrow with a large stone and let the exhaust fumes of carbon monoxide from a car into the other end. Special poison gas bombs can be purchased which are put into the burrow and both ends closed with rocks. Some breeds of dogs are good woodchuck killers.

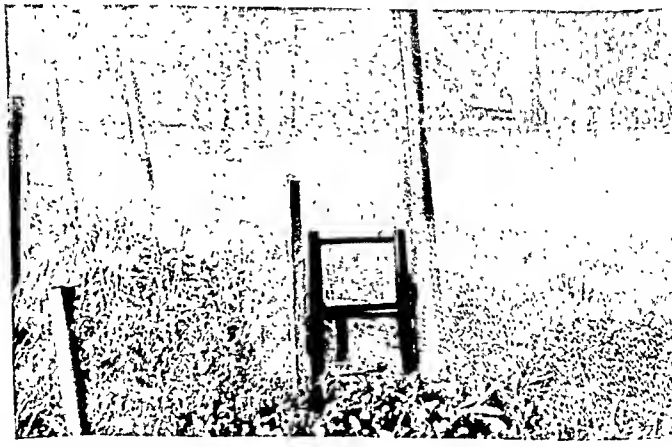
Owls, hawks and crows, which prey upon game birds or their eggs, may be

caught on pole traps. A No. 1 steel trap is placed on one or more of the posts supporting the wire fence. Often predatory birds roost on the top of an exposed post before flying down for the kill. Before setting such traps consult the Conservation Department of your state to find out if pole traps are forbidden or not. Pole traps do not necessarily work in every case. Sometimes the predatory birds will take off from the limb of a nearby tree.

Snapping Turtles

Snapping turtles are a menace to waterfowl. They account for many a duckling or gosling. In fenced-off areas, which include a body of water, seining in the early spring, before vegetation interferes with the dragging of the seine, is a good precaution. Where seining isn't possible, fish lines, with large hooks and tough meat for bait, may be set. Using a float, which may be a stoppered bottle, anchor the line with a heavy weight. The larger the body of water, the more lines should be put out.

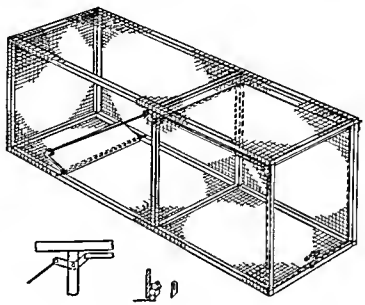
A barrel turtle trap recommended in *Conservation Bulletin 29* of the Fish and Wildlife Service consists of a barrel partially sunk in the water, to which a board is attached by a free-working strap hinge. The board is almost on a balance. Cleats are nailed on the board as a sort of ladder for the turtle to climb up. As he goes up the board and over the balancing point, he drops into the barrel.



Evans vermin trap set along fence. Courtesy of U. S. Fish and Wildlife Service.

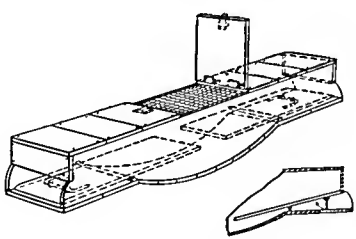
Other Traps for Predators

Since steel traps may catch and kill dogs, game birds and other innocent animals, a number of traps which catch animals alive and uninjured have



U. S. F. & W. S.

Melbrook trap in set position. The door (under near half of top) falls when the treadle is depressed, releasing the trigger shown in the separate outline drawing, and has a special bolt that catches on the frame and holds the door closed.



U. S. F. & W. S.

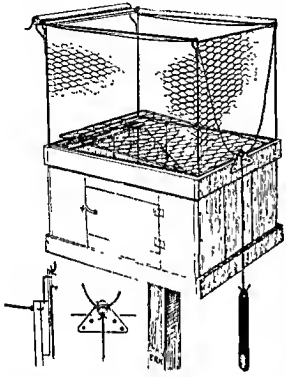
Fooks trap. The middle section of the bottom need not be round, but can be broadly V-shaped.

been devised, some for ground enemies and some for flying predators. The following are suggested in *Conservation Bulletin No. 29*—"The Propagatinn of Aquatic Game Birds," by W. L. McAtee.

The Evans trap is set against the outside of a fence. A short flare of wire is attached to another pole on the fence in such a manner as to form a pathway directing the predator toward the door of the trap. Another method is

to set the trap inside the yard with the mouth against an opening in the fence. Bait is usually not necessary, but it can be attached to the back wall of the trap, when the trap fails otherwise.

The Melbrook trap is all metal, durable, and prevents caged animals from gnawing their way out. It is framed with channel iron, covered with wire mesh, and provided with a door and treadle of heavy-gauge sheet iron. The door falls when the treadle is depressed, releasing the trigger, which has a sliding bolt that catches on the frame and holds the door closed.



U. S. F. & W. S.

Basket trap for hawks. A live chicken or pigeon is kept in the lower part of the trap for bait. A hawk endeavoring to strike the fowl depresses the wire netting floor of the upper part of the trap, releasing the weight, which pulls over the top of the trap the rolled curtain shown at the left.

The Fooks trap is set along fences and covered with brush. It is a tunnel-like box about 40 inches long and eight inches square, which is open at both ends. It contains two treadles, each approximately half as long as the box, which are covered with sheet metal to prevent rats from gnawing out. The treadles are thin at the outer end and fit snugly against the floor in the set position. They pivot at about the middle, and an animal passing this point tips them up at the outer end, which remains raised because of the wire wicket slung underneath. This catches on the floor and prevents the outer end of the treadle from coming down. A door on the top at the middle gives opportunity for inspection through the netting roof.

A basket trap for predatory birds is especially valuable because innocent birds, whose killing is prohibited by Federal laws, may be released from it, whereas the ordinary steel pole trap would maim or kill them.

In such a trap a live chicken or pigeon is kept in the lower part of the trap for bait. A hawk or other predatory bird endeavoring to strike the fowl depresses the wire-netting floor of the upper part of the trap, releasing the weight, which pulls over the top of the trap the rolled curtain shown at the left of the illustration. These traps are attached to the tops of poles.

The Control of Crows

Crows may be shot from behind a blind by imitating a crow's call. Another method is to make a false nest with a few hen eggs in it, and surround the

nest with steel traps concealed in the litter. Poison bait may be used where the bait is out of reach of domestic animals, which might eat it. Powdered strychnine, stirred in an egg through a small hole, is a very effective poison. The small hole is covered with scotch tape and the eggs put in places visited by crows.

A live or stuffed owl is sometimes used as a decoy to kill crows. The owl is set on a perch in the vicinity of a blind. One should not shoot the first crow that appears but wait until the crow flies back and brings other crows to the scene.

10

Pheasants

THE PHEASANT IS ONE OF THE BIRDS WHICH WERE WELL KNOWN TO THE ancients. The species was discovered by the Greeks on the banks of the river Phasis, about 1263 B.C., and was called by them Phasianus ornis—the Phasian bird. Within this genus Phasianus, one species, the Japanese pheasant Phasianus versicolor, is separated from the other species, P. colchicus, by having the underparts wholly metallic green. The latter species is divided into 23 subspecies of which but two, the English pheasant P. colchicus colchicus Linne, and the Chinese pheasant P. colchicus torquatus Gmelin, have been introduced into North America. The hybrid of the English and Chinese pheasants, known as the ring-necked, is the most common in the United States.

The first really successful introduction of pheasants into the United States was in the Willamette Valley in Oregon in 1882. English pheasants were introduced in the East in New Jersey in 1887. At present, wild pheasants are listed as game in 43 states of the union.

Pheasants are essentially birds of the open or brushy country and are not usually found in woodlands. They are fond of swampy or reedy areas, old hayfields and wheatfields where they may hide from their natural enemies. In the East, they stay mostly in hedgerows and thickets, while in the West they prefer the irrigated land bordered by sagebrush. Small bands are the rule, and a covey of from seven to ten birds is most common. During the winter, flocks roam the fields and often come to barnyards and associate with domestic fowl. As spring advances, the male birds become less tame, and large flocks break up into smaller ones, sometime before the breeding season begins.

In mating, the male runs around the female with short steps, usually with the tip of a partly outstretched wing describing an arc on the ground, and stops in front of her. This is known as the season of display. The neck

is bent and the head kept low. After a few seconds, the plumage is allowed to fall back into its natural position as the bird gives out a hissing sound. The male bird usually chooses a definite territory, and from a vantage point such as a fencepost or rise of ground, utters his bisyllabic call. This is interpreted as a warning to other males to keep out.

It is a moot question as to whether pheasants in the wild are monogamous or polygamous. The species is definitely polygamous in captivity. Beebe believes that where there is a surplus of females, the birds may be polygamous, but often an individual male may be monogamous, and care for its mate and brood.

According to the late Prof. Howard M. Wight,* the breeding habits of the pheasants are as follows: *The Sexual Cycle:*—Seven phases in the pheasant's annual cycle are recognized:

1. The interphase lasts from late summer until January and follows the summer moult. During this phase, the genital organs are in a shrunken and nonfunctional condition.

2. The premating phase is characterized in the males by rapid development of the testes. It culminates in concerted crowing and fighting among the cocks. They seek the hens but copulation does not take place.

3. The mating phase is characterized by a general breaking-up of flocks of hens, mating of males and females, copulation, and establishment of territories.

4. The laying phase is that during which the nests are built and the eggs are produced; copulation continues.

5. The incubating phase covers the period when the hens are incubating. Copulation does not occur during this period and the male appears to he isolated from the hen.

6. The brooding phase during which the young are constantly attended hy the females, and not infrequently by the cocks, after the broods are a few weeks of age.

7. The postnuptial phase covers the period when the cock birds are in moult. During this period there is a pronounced and sudden decrease in the size of the testes. The cock becomes solitary, generally stops crowing-behavior which indicates a marked change in his physiological condition.

The interphase comes to an end about the first of the year when growth of the sex organs of the male begins. During the fall and winter there is a general segregation of hens and cocks, although groups made up of both sexes often are observed where roosting cover is restricted or where the birds have congregated because of abundant food.

With the first warm days of February, the cock pheasants begin concerted

*From The Ring-Necked Pheasant and Its Management In North America—Edited by W. L. McAtee, American Wildlife Institute, Washington, D.C.

crowing. Fighting between cocks in the presence of females becomes a common occurrence. The activities of this period appear affected by temperature, being conspicuous during warm periods and almost lacking during cold spells. The exact time when the premating phase begins is difficult to ascertain because the pheasant cocks, like domestic roosters, begin to crow while still immature. They continue to crow occasionally during the fall and winter, so fighting seems the best indicator. It is followed by the breaking-up of the flocks of hens.

When the hens attach themselves to a cock and his "crowing area," they promptly build their nests and start laying their clutches. This activity is followed by the incubating, and finally the brooding, periods. If weather is responsible for a good or poor pheasant year, it must be through its effect upon one or more phases of the sexual cycle.

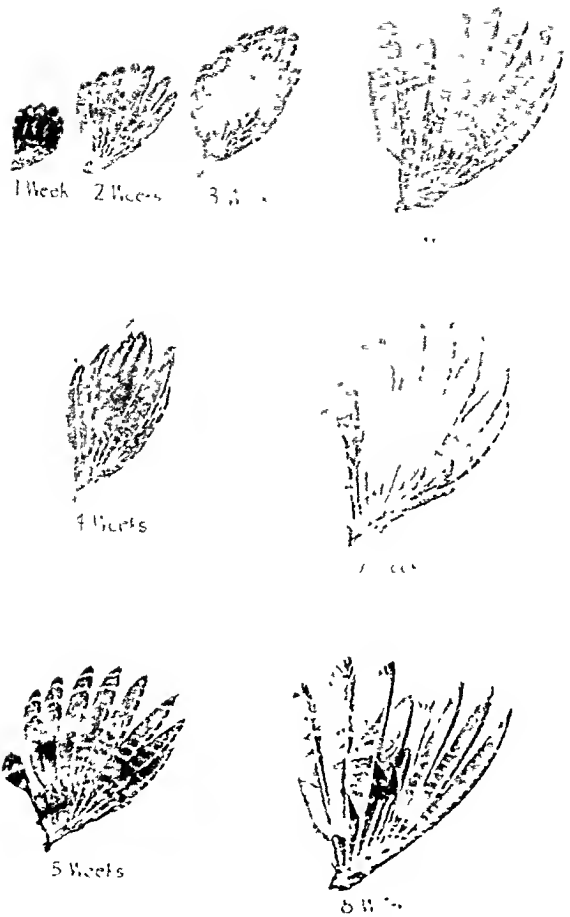
Pheasants usually begin to lay in April or May, depending upon the latitude in which the birds are living. Sometimes two broods are raised in a single season. The female incubates the eggs with no assistance from the male. Her coloration and her lack of scent serve to protect the setting hen on her nest. The female has an almost perfect grass pattern which makes her extremely inconspicuous. Her lack of body odor prevents any feral enemies from detecting her while she is incubating.

It seems to be characteristic of incubating pheasants to be without scent, since instances are known where bird dogs have been let loose in places where there are many pheasants, and have failed to find any females. It has also been established that newly hatched young have no odor, although they acquire an odor as they grow older. The nest is usually made by the female which scratches a slight hole in the ground and lines it with leaves or grasses. The nests, which are almost always in the ground, are usually found in wheatfields or hayfields, and most often fairly near a body of water.

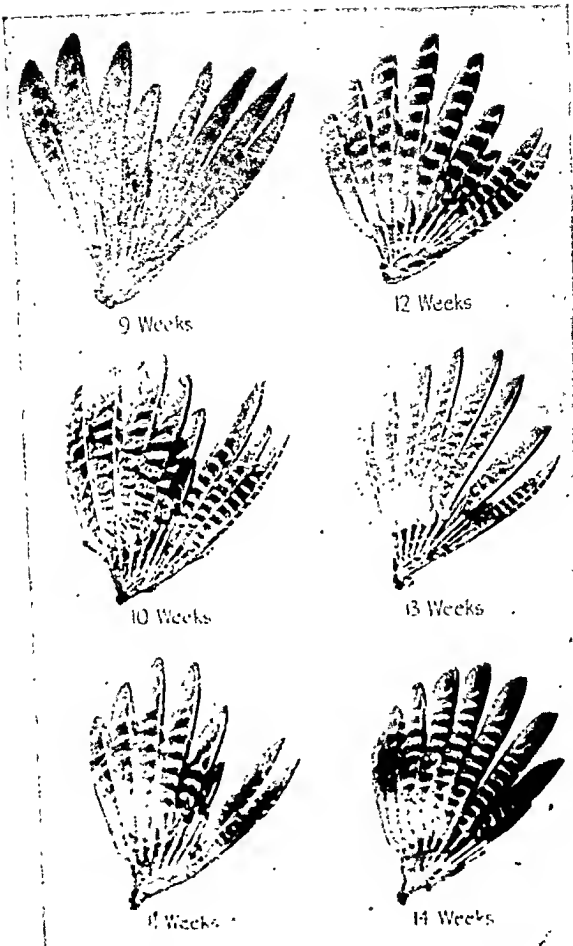
Pheasants, especially those raised in captivity, will frequently deposit their eggs in the nests of other birds. Eggs are generally laid in the evening, usually at intervals of 24 hours. In New York state, an average clutch is from nine to 17 eggs. Sometimes two or more pheasants will lay in the same nest, in which case as many as 30 eggs may be found. Pheasants lay more eggs in captivity than they do in the natural state. A single hen may be expected to produce anywhere from 40 to 50 eggs. In color, pheasant eggs are an olive buff tint, but they may vary anywhere from a light teagreen to a dark olive buff. The shapes of the eggs vary considerably. However, the eggs are normally ovate, and quite rounded at the smaller end.

Incubation in the State of Nature

After the pheasant hen has completed her clutch of eggs, she begins incubating. If she is discovered by man before she has been setting two weeks,



Flight feathers at ages from one to eight weeks. Note the change in growth
Courtesy of Irven O. Buss, Wisconsin Conservation Department



Flight feathers at ages from nine to fourteen weeks. Courtesy of Irven O. Buss, Wisconsin Conservation Department.

her instinct is to desert the nest. When frightened from her nest after this period she usually returns, providing the disturbance is not too great. The period of incubation varies from 23 to 27 days. During the hatching, and until they are from 12 to 24 hours old, the young pheasants are brooded by the parent, first on the nests, then, when the young can travel, away from the site, although not more than a few feet. In this early period, the brooding pheasant will not desert her young. After a few days the hen will lead the young chicks off in search of food, but will stop and brood them at short intervals.

The female undertakes all care of the young until the birds are from six to seven weeks old. After this time, the cock bird occasionally wanders with the flock.

During the first four days of a chick's life, there is not much change in weight. After the birds are 30 days old, they become fully feathered except for the sides, the fronts of their necks and the legs. At 37 or 38 days, the birds are in full juvenile plumage. The sexes of pheasants can be distinguished when the young birds are about five weeks old. By that time, the males can be determined by the buffy color of the breasts, the greenish upper tail coverts, and the bare area on the side of the face. Spurs often begin to develop at this age. The female does not have the spur. At seven weeks, sex identification is unmistakable.

Shortly after they have assumed their full juvenile plumage, pheasants begin to moult for their adult coloration. The proportion of sexes is approximately equal. When the birds are between 16 and 18 weeks old, they are in their first adult plumage.

Pheasants do not increase in weight until they have obtained most of their feathers. Then they begin to grow noticeably, day by day. The weights* of birds are as follows:

Age (days)	*Weight (grams)*
2	18.2
4	19
9	26.4
10	26.8
11	30.2
13	29.5
18	63.0
25 male	134
25 female	109
29 male	186
34 female	134
36 male	278

*Weights by Dana J. Leffingwell—THE RING-NECKED PHEASANT, State College of Washington

Habits

An undisturbed pheasant has a characteristic slow and dignified walk, the average length of each step being about four inches. They do not go far without looking about them, as their need for vigilance is constant. When frightened, the male flies away, while the female usually crouches, relying upon her protective coloration. Both sexes will fly when threatened by dogs or foxes. Male pheasants in particular are very adept at running off through vegetation without moving a grassblade. They can travel very swiftly this way, holding their bodies low, necks outstretched parallel to the ground. By measuring tracks in the snow, it has been determined that the average distance between tracks of running birds is about six inches when the bird is in the vegetation, about 12 inches when it is in the open.

The flight of pheasants is quite swift, the cock birds being stronger fliers than the hens. The distance which a pheasant can fly is something less than a mile.

As a rule, pheasants prefer to spend the night on the ground, although it is not uncommon to find them roosting in trees. Like many birds, pheasants are fond of dusting to control body lice and mites. This is characteristic of most birds that live on the ground.

Enemies

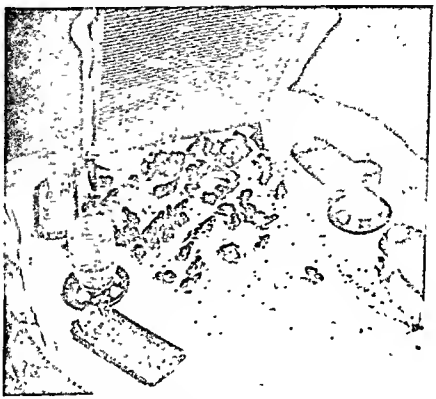
Pheasants are killed by predatory birds and animals, set upon by dogs and cats, destroyed by forest fires and mowing machines. The mink, skunk, weasel, fox and coyote are among their enemies. Hawks and owls as well as crows and magpies are among their worst enemies, crows and magpies especially so during the breeding season, as both have a great liking for eggs and newly hatched young.

Feeding and Foods

In the state of nature pheasants usually feed in the early morning and again before sunset. During the day they will take insects and seeds as they see them, but there is no purposive search for food during these hours. This has been determined by examination of their crops at the time when they have been shot. Feeding takes place quite locally during the breeding season, and it is probably to insure a good food supply for his mate that the cock defends his chosen territory.

The foods of pheasants are weed seeds, insects and cultivated crops. The cereal grains are preferred and corn is one of the favorites. Beetles form the largest portion of a pheasant's insect diet, and as many as 42 species of in-

sects and the seeds or fruits of 101 species of wild plants have been found in their stomachs. Wild raspberry and wild black cherry seem to be their favorite fruits. As a rule pheasants seem to feed on whatever is easiest to obtain. It is generally believed that during the summer pheasants are for the most part insectivorous. As many as 47 grasshoppers have been found in the crop of a single pheasant. June-bugs, caterpillars and even ants are also part of their diet.



The use of a white cloth underneath the hover. Note the feed sprinkled on cloth and birds eating. Courtesy of Wisconsin Conservation Commission.

While pheasants are considered injurious to some cultivated crops, the net results of their consumption of pests more than balances the scales. They are known to destroy many field mice. Coating the seeds of newly planted grain with coal tar will prevent their consumption by pheasants.

With this brief introduction to the habits of pheasants in their natural state, we are ready to consider the various questions involved in raising them domestically.

11

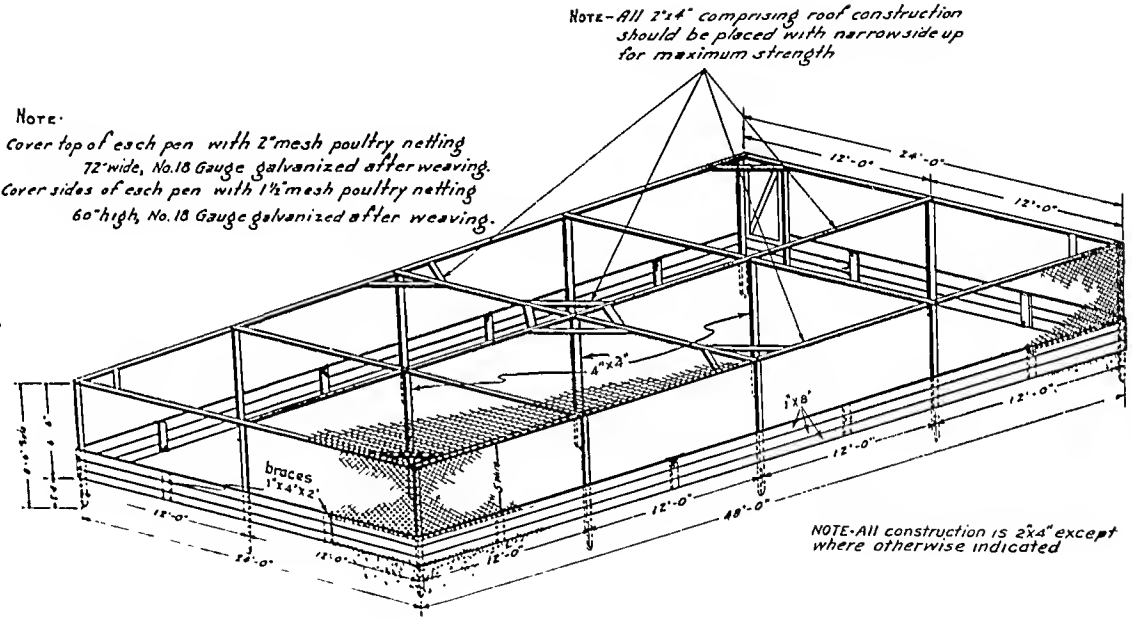
The Growing Pheasant

THE GUARD IN A SMALL BROODER HOUSE SHOULD BE REMOVED FROM around the hover after the fourth day when the chicks know their way about and have learned to find the water and feed. On the tenth day, if the weather is fair, they should be allowed out-of-doors in small runways made of three-quarter-inch mesh wire, but for only a few hours during the heat of the day. The time they are permitted out may be increased gradually in good weather, but they should be forced back into the brooder if the weather is stormy. After they are 14 days old, they may be left out all day in good weather.

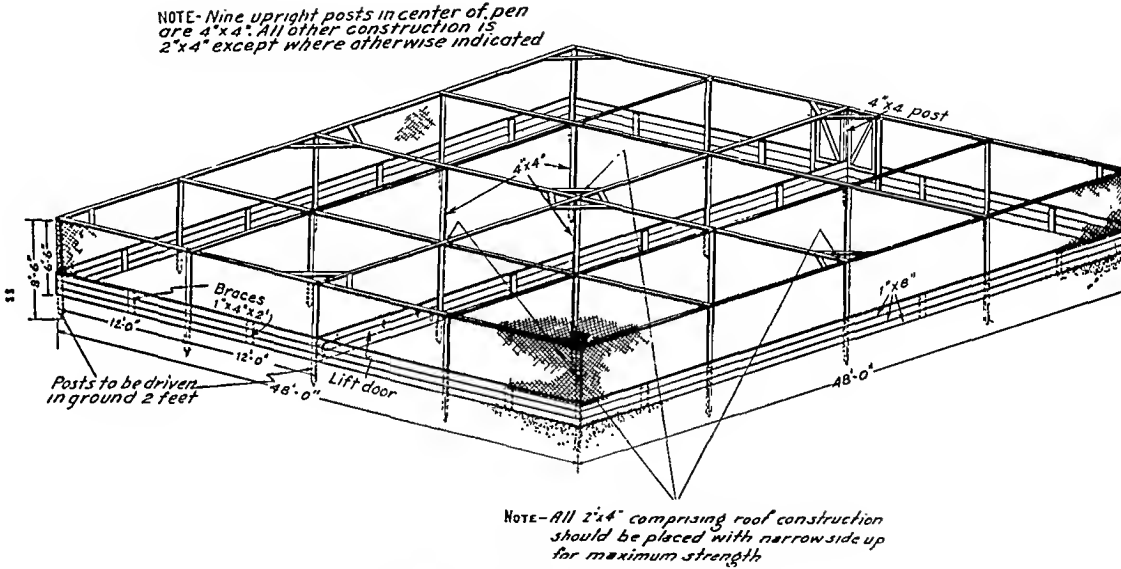
If there is no wire cover over the outside pen, it will be necessary to clip the main or primary flight feathers of one wing so that the bird is unbalanced if it tries to fly over the enclosure. It will be necessary to cut the primaries again when the birds are four weeks old. An ordinary landing net is generally used to catch the birds for clipping, and a pair of scissors is all the equipment needed.

Rather than swing the net at the birds as you would in catching a butterfly, it is better to allow the birds to run into the net of their own accord. They may be removed from the net by grasping both legs. The breeder should not get hold of one leg at a time. With the thumb over the head of the bird and two fingers between the legs, the operator should spread the wing feathers and then clip the first eight flight feathers. The wing must not be clipped too closely.

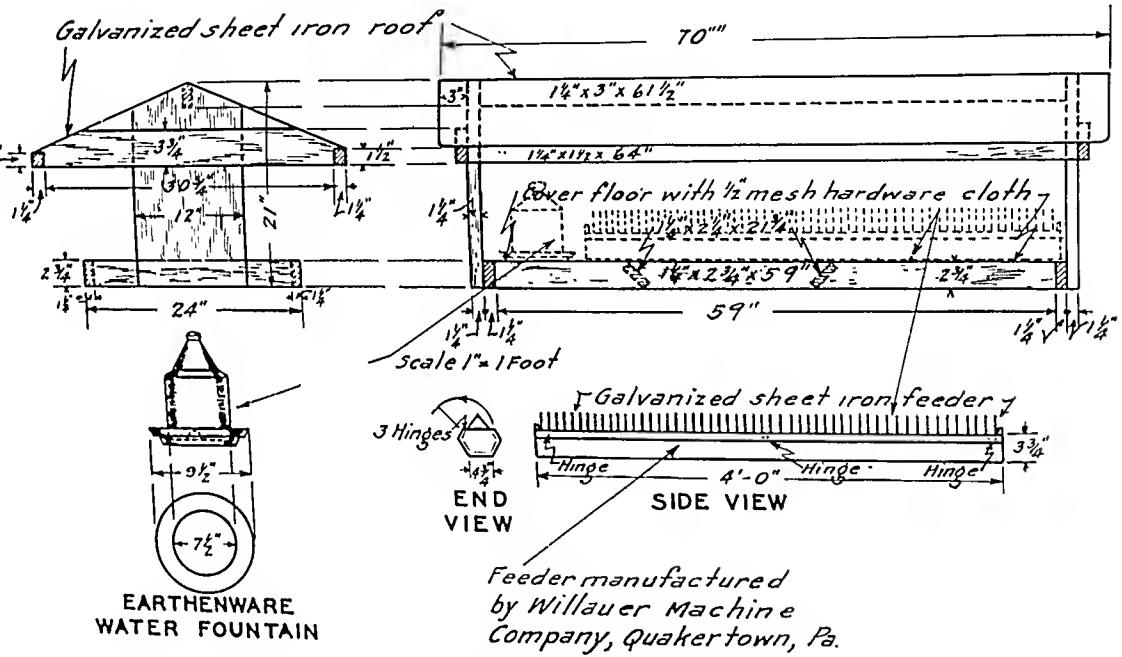
When chicks are ready to leave the house for the first time, care must be taken to avoid *driving* them out; they are easily frightened and may fail to come back. When the door is opened, feeders and water fountains should be placed in the yard near the entrance to the brooder house, and the chicks



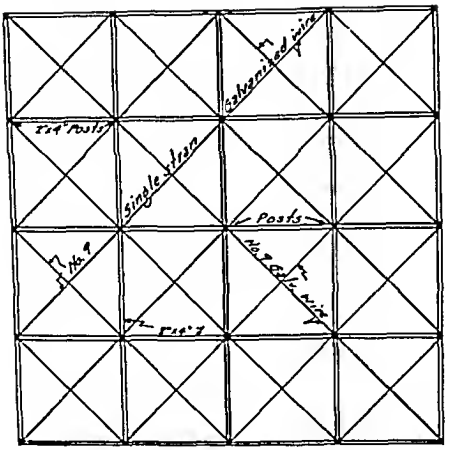
Single pen. Courtesy of Pennsylvania Game Commission.



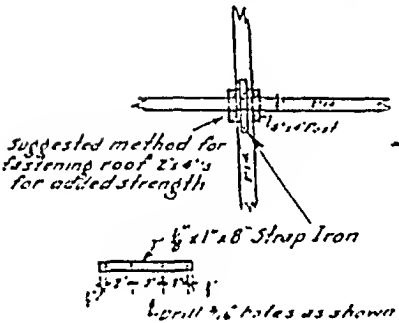
Double pen. Courtesy of Pennsylvania Game Commission.



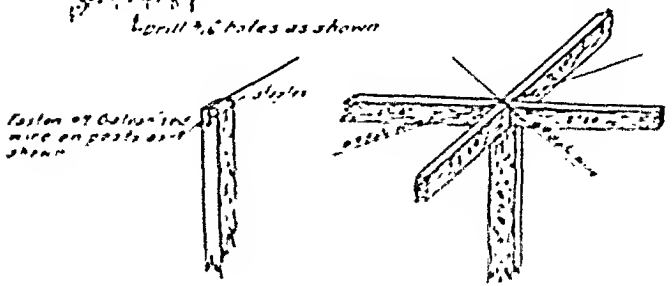
Combination feeder and water fountain.



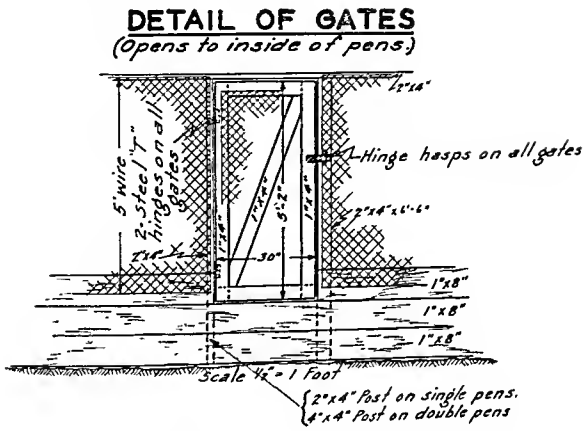
DETAIL SHOWING STRINGING OF No. 9 GALVANIZED WIRE ON TOP OF PENS.



POULTRY NETTING ON TOP OF PEN IS JOINED TOGETHER WITH GALVANIZED PIG RINGS

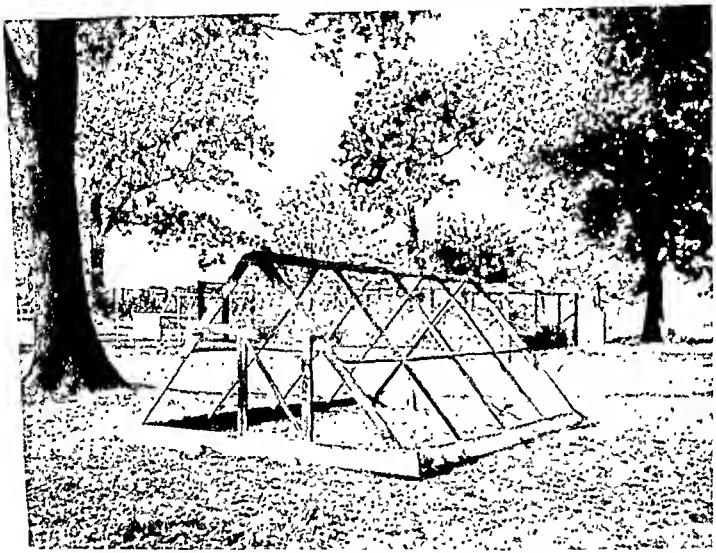


Details of roof construction.



Other details.

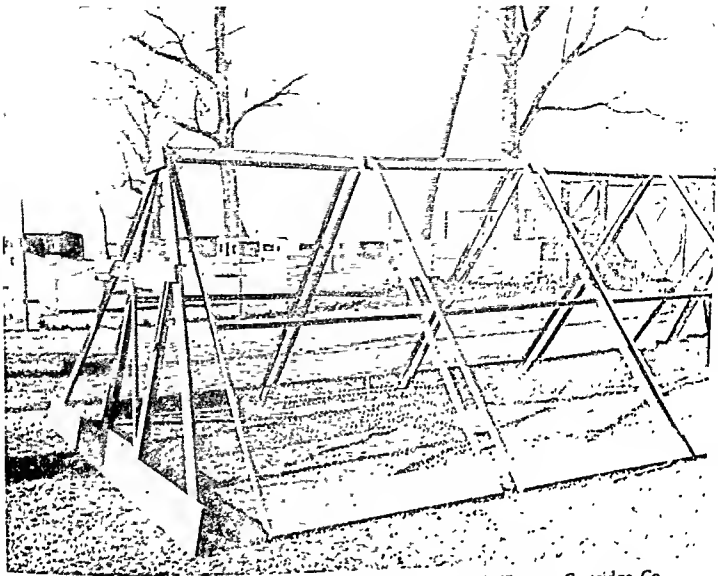
will gradually learn to come out by themselves. In the evening, the feeders and water fountains may be replaced in the house, and it will usually be found necessary to force the chicks back. The grass around the fence and several paths leading to the brooder house should be kept trimmed. In about three weeks, the chicks will return to the brooder house of their own accord in stormy weather. After four weeks, during good weather, the birds may be allowed to remain in the run overnight if they prefer.



Adapting pen. Courtesy of Western Cartridge Co.

The wire for the first two feet above the ground should consist of one-inch mesh, and above that, the next four feet should be one and one-half inch mesh. The top of the pen, when a cover is used, which is usual, may be of two-inch mesh. In stretching the wire over the top of the pens, it should not be pulled taut. Rather let it slope down to about one foot at the center. Then if frightened pheasants fly against it, there will be less danger of their hurting themselves than if the wire is taut. All wire should be 18 gauge or heavier. Two-foot baseboards are frequently used on pens, but there should be a wire leading from the base of these into the ground to prevent predatory animals from getting in.

The cover in a holding pen should be spaded or plowed with a small tractor and re-sown each spring. This acts as a disinfectant and kills off disease germs. Where small pens are used they may be mounted on runners and hauled to fresh ground several times during a season. This is not possible with large pens, and re-seeding is therefore necessary after the ground has been prepared. The Pennsylvania Game Commission recommends planting a good game food mixture such as amber sorghum, Japanese broom corn, golden or German millet and sunflower, to be sown at the rate of eight



Adapting pen, showing details of assembly. Courtesy of Western Cartridge Co.

pounds per acre. This mixture need not be sown over the entire area, but in strips, allowing room for a caretaker to walk about through the pen.

Releasing the Birds

If birds are to be set free in a definite area, other than their holding pens, a temporary collapsible triangular adapting pen may be constructed and the birds confined in these. After a few days in their new pens, the door may be left open until gradually they no longer return. The adapting pen, which is sectional, may then be taken apart, folded up, and carried on a wagon or truck to another part of the range. The specifications for one of these adapting pens, as described in the booklet *Upland Game Propagation*, published by the Western Cartridge Company, are as follows: make up sections four feet wide, eight feet from base to top. Hinge at the top. Sections are bolted to each other. The ends are separate pieces and they are bolted to the rest of the pen. A 19-gauge one-inch mesh wire is used to cover the sections. A flange of mesh wire should extend outward from the base of the pen, and should have dirt thrown over it. This will keep the birds in and the predators out.

Into this pen should be placed the feeding and watering utensils. Hanging feed troughs and water fountains can be placed outside of the pen at a level where the pheasants can reach it. Inside the pen a teepee of cornstalks or a pile of evergreen brush is placed to provide shelter from the sun. A tarpaulin of canvas or any other material may be hung over the ridge of the holding pen at one end to provide additional shade and protection from rain. Building an additional four x eight foot section of the holding pen,

Feeding and watering from the outside. Courtesy of Wisconsin Conservation Commission.

covered with homasote or some other light building board, is another way of providing shade and shelter.

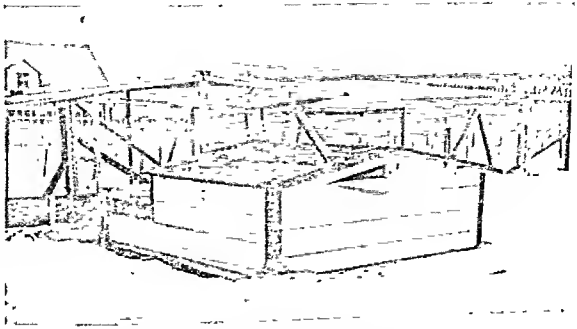
Selecting Breeders

The selection of breeders for pheasant propagation involves the same principles that underlie the selection of breeders in any category of livestock. The vigorous, early maturing specimens are the ones most likely to reproduce desirable offspring. In September or October pick out the most advanced pheasant hens and put them in a pen by themselves. Later the males can be selected on the same basis and also be put in a separate pen.

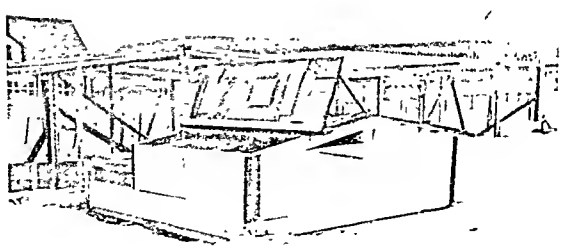
There is some difference of opinion as to what the best ages are for breeding purposes. Some breeders prefer two- or even three-year-old hens mated with yearling cocks. Others prefer yearling hens mated with two- and three-year-old males.

The condition of the birds is important. Males and females should be fully feathered, healthy and active. Don't breed from runts and don't dispose of

your best stock before you select your breeders. Earlier hatched birds will come into egg production sooner than late hatched ones, and will lay more eggs.



Small double brooder house showing ventilator open at one side. Courtesy of Wisconsin Conservation Commission.



Small double brooder house showing door open to expose record sheet, which is essential. Courtesy of Wisconsin Conservation Commission.

Clipping the right wings of each bird will make breeders tamer and will tend to ease their adjustment to winter breeding pens. These pens are the same as other holding pens but are usually protected on the north side by a windbreak of some sort. In open places a windbreak can be made by stacking cornstalks against the north end of the pen. Better still, build an open shed

facing the south at the north end of the pen. This should run across the entire width of the pen. It should be about four feet high in the rear and about eight feet high in the front. Feed hoppers may be set in the shed.

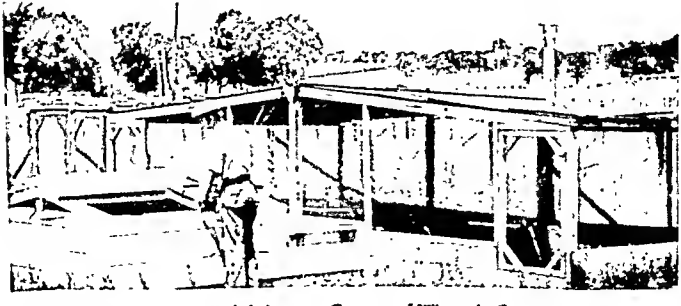
Mr. Thomas Rae, manager of the Aknusti Game Farm, Delhi, New York, has had considerable success with 12 foot x 12 foot pens raised off the ground, with a one-inch x two-inch mesh 12-gauge wire floor. Six hens and one cock are kept in each pen.

In an experiment to determine how many hens could be mated to one cock, Mr. Rae used three separate pens with 12, 15, and 20 hens respectively, each with one cock.

105 eggs were set from the 12-hen pen—98 fertile eggs were obtained. (93%)
158 eggs were set from the 15-hen pen—144 fertile eggs were obtained. (91%)
133 eggs were set from the 20-hen pen—111 fertile eggs were obtained. (83%)

Considerable feather picking was noted during the experiment but no egg eating. Hen-Specks, a sort of blinders which are attached on the beak of pheasants, prevents egg eating and also fighting between cock birds. They should also be used on the females to prevent egg eating. Another method of breaking up the egg eating habit is to punch small holes at each end of one egg, and by blowing at one end, force the yolk and the albumen out at the other. Put these in a dish and mix with red pepper to make a paste. Replace in the egg shell and seal with paraffin. Place this egg in a prominent part of the pen where pheasants are likely to eat it.

Laying hens and their mates should be placed in breeding pens anywhere from two weeks to a month before egg laying begins. Since there is some variation as to when the hens first begin to lay, depending upon the geographical location of the farm, this time must be determined by experience.



Small double brooder house and shelter pen. Courtesy of Wisconsin Conservation Commission.

To increase egg laying and to start the hens laying before they would ordinarily begin, artificial lighting of the breeding pens has been found worthwhile. This duplicates the experience of commercial domestic egg producers. At Aknusti a 50-watt bulb is used in each ten x ten pen. Male birds are given artificial light a full month before the females. Lighting starts the first of March. A time clock is used and lights put on early in the morning. Gradually the length of the natural plus the artificial light is brought up to a point where there were 13 hours of light. No evening lights are used.

RATIONS FOR PHEASANTS

Recommended by Woodrow W. Bailey & Ralph B. Nestler*

(Start one month before the breeding season)

All Mash Breeding Diet (26 per cent protein)	*Pounds*
Ground yellow corn	32.7
Standard wheat middlings	10.0
Dehydrated alfalfa leaf meal	10.0
Dried buttermilk (or skim milk)	5.0
Sardine fish meal	5.0
Soybean meal (high temperature processed)	30.0
Special steamed bonemeal	3.1
Pulverized high grade limestone	2.7
Salt mixture	1.0
Vitamin A and D feeding oil fortified	0.5
Total	100.0

Growing Diet	
Ground yellow corn	11.2
Wheat bran	15.0
Flour wheat middlings	12.5
Ground oats	10.0
Dried skim milk	12.5
Alfalfa leaf meal	5.0
50 per cent protein meat scraps	11.0
White fish meal	2.75
Soybean meal	19.5
Salt	0.5
Vitamin A and D feeding oil fortified	0.25
Total	100.0

Maintenance Diet	
Coarse cracked yellow corn	100
Wheat	100
Oats	50
Buckwheat } or 100 lb. of one	50
Barley }	50
Total	350

*From THE RING-NECKED PHEASANT AND ITS MANAGEMENT IN NORTH AMERICA. Edited by W. L. McAtee, American Wildlife Institute, Washington, D.C.

Pennsylvania Conservation Commission
Ration and Suggestions for Feeding Ring-necked Pheasants

*Starting Mashes**	*No. 1*		*No. 2*	
Ground yellow corn	100	lbs.	170	lbs.
Wheat flour middlings	100	"	100	"
Wheat bran	100	"	100	"
Ground oats	100	"	100	"
Alfalfa meal, low fiber	50	"	50	"
Dried whey	50	"	50	"
Brewers' dried yeast**	30	"	30	"
Meat scrap (not less than 50% protein)	30	"	120	"
Fish meal (not less than 55% protein)	20	"	30	"
Soybean oil meal	400	"	250	"
Steamed bonemeal	10	"	—	"
Ground limestone	10	"	—	"
Salt	5	"	5	"
Fish liver oil (400 AOAC units of D per gram)※	2.5	"	2.5	"
Anhydrous manganese sulphate※※	.125	"	.125	"
	1007.625	"	1007.625	"

Grain Mixture

200 lbs. coarse cracked yellow corn
100 lbs. whole wheat
50 lbs. whole oats

350 lbs.

Barley or buckwheat may be substituted for one-half the corn with satisfactory results.
Calculated analysis of the mashes when good quality ingredients are used.

	No. 1	*No. 2*
Protein	29.0%	29.0%
Calcium	1.4%	1.7%
Phosphorus	.9%	1.2%

Recommended by August Bade, Chief, Bureau of Game Farms, California
Growing Scratch Grains for Young Pheasants

Cracked wheat	50%
Cracked gyp corn	20%
Cracked milo	15%
Cracked oat groats	15%

*Two equally satisfactory formulas are given so that if certain critical ingredients of one are difficult to obtain, the other may be used.

**If necessary, a riboflavin concentrate composed of natural ingredients may be substituted for the brewers' dried yeast. A pound for pound substitution may be made if the riboflavin concentrate contains 35 micrograms of riboflavin per gram of concentrate. Adjustments can be made for concentrates of greater potency. If, for example, a product containing 70 micrograms per gram is used, 15 pounds in place of 30 pounds should be added and the ground yellow corn increased 15 pounds in the mash mixture.

12

The Story of a Going Pheasant Farm

DONALD J. MAC FARLANE, A GRADUATE CHEMICAL ENGINEER, AFTER SPENDing 11 years working for a large industrial organization, felt the need of establishing himself in his own business, and preferably one in which he could combine his love of the outdoors with a means of making a livelihood. His brother, who had started a pheasant farm nine years before, and had made a good thing of it, urged him to go back to their hometown, Janesville, Wisconsin, and start a pheasant farm next to his. Kenneth Mac Farlane was a real conservationist and a great outdoorsman, and these attributes were undoubtedly factors in his successful pheasant business. When his brother Donald started on his own, he had the advice and cooperation of Kenneth, and although each brother ran his business separately, they worked back and forth on a mutually advantageous basis.

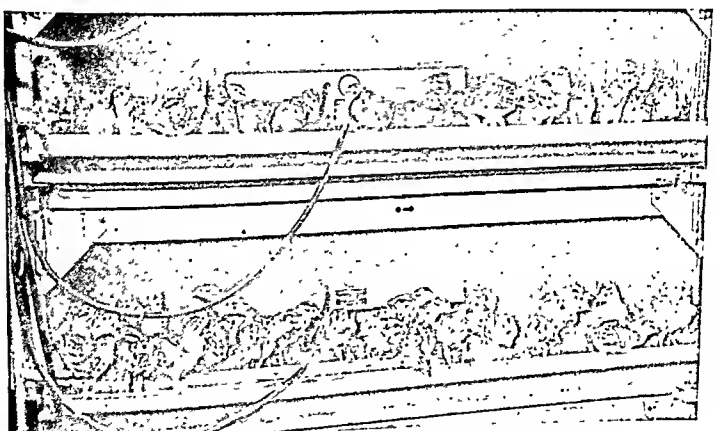
This happy state of affairs existed until Kenneth lost his life in the Armistice Day storm of 1940, while duck hunting on the Mississippi. Many others were lost in this same storm. Shortly after, Donald purchased Kenneth's farm from his widow, and combined operations of both farms. With but a shoestring of capital and only two years' experience, Donald was on his own when World War II started. All of the experienced help of both farms were soon called to the colors, and Mac Farlane found himself operating with inexperienced help. Notwithstanding, he succeeded in raising 8600 mature pheasants, which was about the number he and his brother had raised together when operating independently. Moreover, there were the usual handicaps of operating a farm of any kind during the war years. Feed was high and scarce, machinery and equipment were unavailable, and major repairs had to be postponed until the war was over.

In the process of reorganization and replacement after the war, Mac Far-

Donald J. Mac Farlane.

lane developed pneumonia. After recuperation he took a trip and came down with polio. It was a bad case, which required the services of three nurses for several months, and one had to stay on with him for ten and a half months.

The force at the farm carried on, and in spite of the incapacity of Mac Farlane, the years 1946 and 1947 were profitable ones. From his sickbed he directed operations, and in fact he attributed his remote control of the business as a considerable therapeutic factor in his rapid progress toward recovery. Constant exercises, necessary afternoon naps, and all the unpleasant concomitants, which attend the slow recovery from this dread disease, did not prevent Mac Farlane from increasing his production of pheasants 35 per cent



Pheasant chicks in Jamesway Electric Batteries on the Mac Farlane farm.

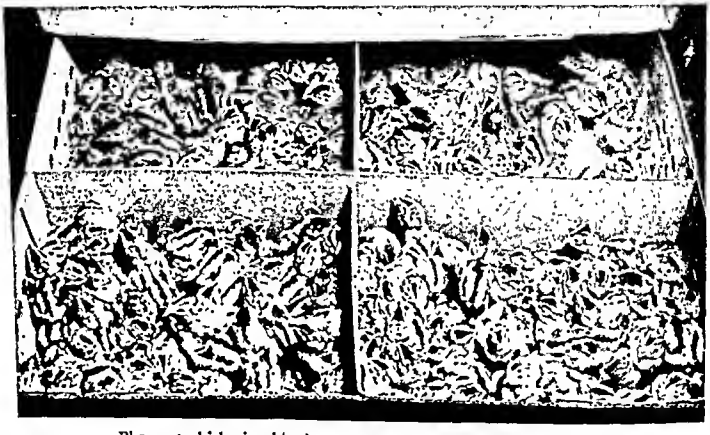
over the years preceding his illness. In 1944 his production was 8600 mature birds, in 1945, 11,000, and in 1946, 12,500. In addition to the operation nf his own farm he found time to be active secretary of the Wisennsin Pheasant Breeders Association, and to serve as one of the Board of Directors of the North American Game Breeders Association.

Mac Farlane is slowly recovering, runs his own car with hand cnntrols, and can now walk down the back steps of his home and out to his car with the aid nf walking sticks.

The story of the actual operation of the farm may serve as a living example to prospective pheasant breeders. For years he had his eggs hatched in a cnmmercial hatchery, but in 1948 he purchased incubators and thereby confined the entire operation to his own farm. While this entailed additional

work, it kept the eggs and chicks on his own place and made his operation entirely independent.

After being taken from the incubators the chicks are toe punched for pedigree records. They are then placed in Jamesway battery brooders for from seven to 11 days. The batteries are in a warm room with a temperature of 85° minimum for the first few days. The temperature is then lowered to 80°. The battery brooders are valuable for the first five days since the temperature is kept almost constant, and the chicks are *not* subjected to the vagaries of the weather at their tender age. The close confinement of the batteries helps the chicks learn to eat and keeps them from straying out into



Pheasant chicks in shipping cartons on the Mac Farlane farm.

the cold. After the seventh or tenth day the chicks are moved into the brooder house. Within that range, moving day depends on when the next hatch is coming off, as the new batch must be put into the batteries.

Mac Farlane does a considerable baby chicks business so that most of the chicks coming out of the incubators are shipped to other breeders. These are for the most part in neighboring states, but successful shipments have been made to California, Florida, Oregon, Maine and Canada.

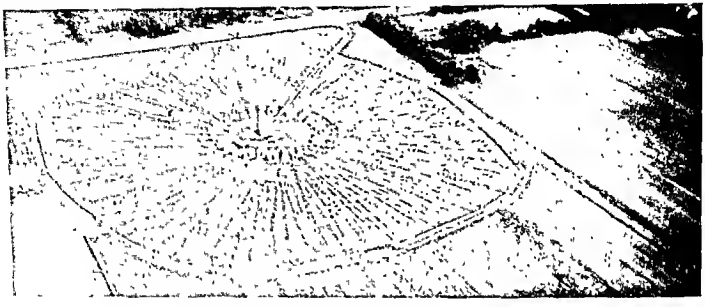
The brooder houses are provided with electric chicken hovers. On about the 12th day the birds are allowed to venture outside into small triangular pens that are 16 feet long. This is done after they have had the flight feathers of their right wings clipped. The chicks are permitted outside for an hour in the morning, and an hour in the afternoon if the weather is favorable. This

is the procedure for the first one or two days after the 12th day. The long narrow pens make it easy to drive them in at night. The pens are 180 and 200 feet long and 60 feet wide at the end away from the brooder house. The houses to which these yards are attached hold 250 and 300 chicks. The hovers are 36 inches square and are the kind that are used for domestic chicks. Mac Farlane designed the circular system of brooder pens with 30 brooder houses set in a circle about 120 feet in diameter. The area of the entire circle is about five acres. The feed house is in the center of the circle. The 30 houses hold 8000 chicks at one time.

Pheasant chicks in brooder house on the Mac Farlane farm.

The pens all have sod bottoms which are kept mowed, except for strips of sunflowers and rape down the centers of the run. Water is piped to the center of the circle. The brooder house circle is surrounded with an eight-foot fence of chicken wire. The bottom two feet are one-inch mesh, the top six feet are two-inch mesh. The dividing fences between the pens are two feet of one-inch mesh at the bottom and four feet of two-inch mesh at the top. None of the pens are covered with wire. Occasionally the young pheasants fly from one pen to another which is not bad, but if they fly out of the circle it is serious. The flight feathers are clipped every 14 to 17 days.

When the birds are six and a half weeks old, their wings are clipped again and they are moved into the larger range fields. At about nine weeks the half feathers that have been clipped are all pulled. Brails are put on the left wing at 11 to 12 weeks. It is necessary to change the brails to the right



Circular range yards at the Mac Farlane farm.

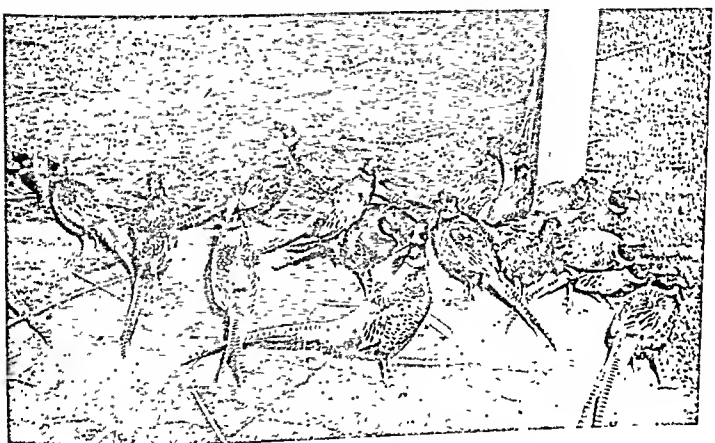
wing in about three weeks. This allows the left wing to limber up quickly, and diminishes the time required in the larger covered pens before the mature full-flying pheasants are sold for restocking or shooting.

There are 20 range fields of from two to ten acres each. These fields are

Young hen pheasants on the Mac Farlane farm.

planted to oats and rape, or wheat and rape. The rape grows after the grain is combined and makes excellent cover. Some of the fields are left in sod with strips of clover seeded each year. The cover is sunflower, sorgo, rape, millet and broom corn. Other fields are planted to corn. As a result of this varied planting there is excellent cover and a considerable amount of feed produced. The rape is not only good for cover but also provides succulent green feed.

The Mac Farlane Pheasant Farm has been one of the largest suppliers of hatching eggs in the United States, because of a rigid policy of culling, and



Young male pheasants on the Mac Farlane farm.

hatching only well-formed evenly shaped eggs. Egg shape is a hereditary characteristic and consequently the pheasants hatched from these eggs have a tendency to lay mostly well-shaped eggs.

Mac Farlane feels that while commercial crumbles and pellets especially made for pheasants have a distinct advantage in that they are less wasteful, mixing his own feeds is more economical in the long run. Situated in the midst of a dairy and grain section, he can buy more dried milk, dried whey, and brewers' yeast than are usually found in commercial mixtures, and at a lower cost. His experience as a chemist stands him in good stead in making up his rations.

The farm specializes in the production of quality pheasants and has been able to market them at premium prices. Most of them go to hunting clubs, state conservation departments, and individuals who purchase the birds to

stock or shoot. The food market is incidental because it is at times flooded with the surplus of other pheasant farms, which brings the price down to an unprofitable level. Mac Farlane has always found a real market for his birds as breeding stock for other pheasant producers, who introduce outside blood into their own breeding strains.

A consistent policy of advertising in five of the leading sporting magazines since 1929 has brought the farm before the public. Quality stock and a liberal adjustment policy has made many customers.

Some idea of costs and prices may be gathered from the following data:

	1939 & 1940		*1948*
Eggs in early May	per 100	$12	$25
	per 1000	$100	$200
Chicks in early June	per 100	$22	$40
	per 1000	$200	$400
Mature birds in the fall each	$1.50		$3.25
Mature birds in the spring for release	$2.00		$4.00

Feed prices in 1948 about two and one-half times more than in 1939.
Labor prices in 1948 about three times as much as in 1939.
Equipment and replacement prices have also gone up considerably.

13

Bobwhite Quail

FOR A DESCRIPTION OF BOBWHITE QUAIL, *COLINUS VIRGINIANUS,* WE turn to Audubon. The common name given to this bird in the eastern and middle districts of our Union is that of quail, but in the western and southern states, the more appropriate appellation of partridge is bestowed upon it. It is abundantly met with in all parts of the United States, but more especially towards the interior.

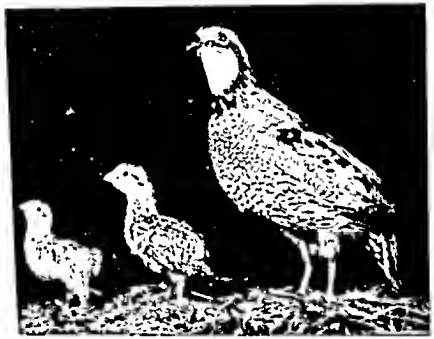
Jack A. Stanford, Missouri Conservation Commission

Newly-hatched quail are clothed in natal down and appear about the size of a hulled walnut. Note their alert appearance at six hours of age

The flight of these birds is generally performed at a short distance from the ground. It is rapid, and is continued by numerous quick flaps of the wings for a certain distance, after which the bird sails until about to alight, when again it flaps its wings to break its descent. When chased by dogs, or startled by any other enemy, they fly to the middle branches of trees of ordinary size, where they remain until danger is over. They walk with ease on the branches. If they perceive that they are observed, they raise the feathers of their head, emit a low note, and fly off either to some higher branch of the same tree, or to another tree at a distance. When these birds rise on wing of their own accord, the whole flock takes the same course; but when flushed (in the sportsman's phrase), they disperse, after alighting, call to each other, and soon after, unite, each running or flying towards the well-known cry of the

patriarch of the covey. During deep and continued snows, they often remain on the branches of trees for hours at a time.

The usual cry of this species is a clear whistle, composed of three notes; the first and last nearly equal in length, the latter less loud than the first, but more so than the intermediate one. When an enemy is perceived, they immediately utter a lisping note, frequently repeated, and run off with their tail spread, their crest erected, and their wings drooping, towards the shelter of some thicket, or the top of a fallen tree. At other times when one of the flock has accidentally strayed to a distance from its companions, it utters



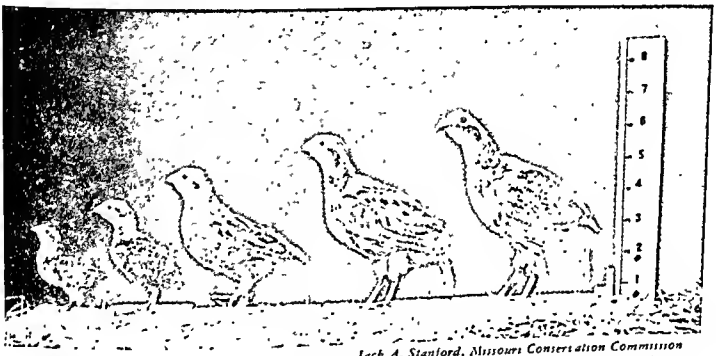
Jack A. Stanford, Missouri Conservation Commission

The characteristic sequence of the: (1) natal down, (2) juvenile feathers and (3) adult plumage are shown here. Age of birds, left to right: one week, two weeks, 16 weeks. Natal down chick is becoming flecked with juvenile feathers. The two-week-old bird shows juvenile plumage on wings and side, with natal down predominating on head. The almost-adult bird possesses the true color markings and heavy feathering of the full-grown quail.

two notes louder than any of those mentioned above, the first shorter and lower than the second, when an answer is immediately returned by one of the pack. This species has moreover a love-call, which is louder and clearer than its other notes, and can be heard a distance of several hundred yards. It consists of three distinct notes, the two last being loudest, and is peculiar to the male bird. A fancied similarity to the words Bob White renders this call familiar to the sportsman and farmer; but these notes are always preceded by another, easily heard at a distance of 30 or 40 yards. The three together resemble the words Ah Bob White. The first note is a kind of aspiration, and the last is very loud and clear. This whistle is seldom heard after the breeding season, during which an imitation of the peculiar note of the

female will make the male fly towards the sportsman, who may then easily shoot it.

In the middle districts, the love call of the male is heard about the middle of April, and in Louisiana much earlier. The male is seen perched on a fence-stake, or on the low branch of a tree, standing nearly in the same position for hours together and calling Ah Bob White at every interval of a few minutes. Should he hear the note of a female, he sails directly towards the spot whence it proceeded. Several males may be heard from different parts of a field challenging each other, and should they meet on the ground, they fight with great courage and obstinacy, until the conqueror drives off his antagonist to another field.



Jack A. Stanford, Missouri Conservation Commission

Growth size and feather development of the quail, ranging in age from, left to right one week, two weeks, four weeks, six weeks and eight weeks. Note throat development.

The female prepares a nest composed of grasses, arranged in a circular form, leaving an entrance not unlike that of a common oven. It is placed at the foot of a tuft of rank grass or some close stalks of corn, and is partly sunk in the ground. The eggs are from ten to 18, rather sharp at the smaller end, and of a pure white. The male at times assists in hatching them. This species raises only one brood in the year, unless the eggs or the young when yet small have been destroyed. When this happens, the female immediately prepares another nest; and should it also be ravaged, sometimes even a third. The young run about the moment after they make their appearance, and follow their parents until spring, when, having acquired their full beauty, they pair and breed.

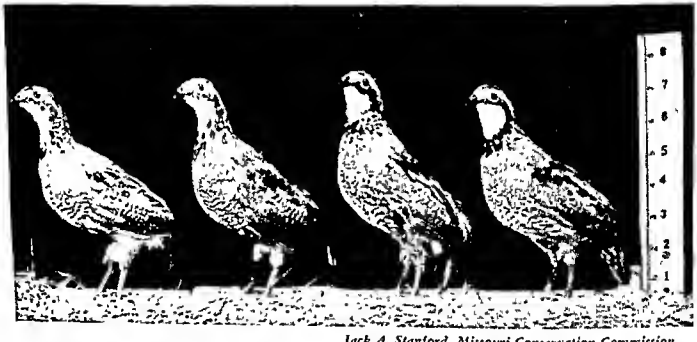
The bobwhite rests at night on the ground, either amongst the grass or under a bent log. The individuals which compose the flock form a ring, and moving backwards, approach each other until their bodies are nearly in con-

tact. This arrangement enables the whole covey to take wing when suddenly alarmed, each flying off in a direct course, so as not to interfere with the rest.

These birds are easily caught in snares, common deadfalls, traps and pens, like those for the wild turkey, but proportionate to the size of the bird.

The bobwhite is easily kept in cages or coops and soon becomes very fat. The ordinary food of the species consists of seeds of various kinds and such berries as grow near the surface of the ground, along with which they pick up a quantity of sand or gravel. They suffer greatly in the middle districts during severe winters and are killed in immense numbers.

Bobwhite quail in its wild state is difficult to observe because of its concealment in the ground cover and its alertness to the presence of an observer



Jack A. Stanford, Missouri Conservation Commission

An illustration of further development, with the birds aged, left to right, at ten weeks, 12 weeks, 14 weeks and 16 weeks.

from whom it speedily flees. They usually travel in coveys. Mating occurs in the spring when the frequent bobwhite calls announce the nuptials. The males travel together peacefully until females appear on the scene, when they take to fighting, puffing out their feathers and attacking each other with lowered heads.

The nesting period extends over a long period, sometimes from late April until October, but most nesting occurs from May until August. The nests are usually found along open roads, edges of fields, pathways, and sometimes in open fields and sometimes in brush. The nests are constructed of grasses, pine needles, and any other materials available near the site, as is the case with most other kinds of birds. In almost every instance noted, the male birds build the nests. Eggs are laid once a day until the clutch is complete. Each day the egg is laid one hour later. About 15 eggs comprise an average clutch, which the hen lays in from 15 to 17 days.

The incubation period is approximately 23 days. Incubation may be performed by the male or the female, more frequently by the latter. A cock bird will take over the incubation if his mate is killed before the hatch comes off. However, the avoidance of the nest by the mate during the incubation is characteristic of bobwhites. This is true of both male and female. If the female is incubating, the male will stay a short distance away from the nest and vice versa. Frequent turning of eggs by the beak occurs during the whole incubation period. Droughts are deterrents to high hatchability and wet weather extremely favorable. Percentages of hatchability range from 85 to 92 on the average. In many cases every egg is hatched. It must be noted that while wet weather is extremely favorable for hatchability, normal temperatures and precipitation are better for actual reproduction. Newly hatched chicks average less than one-quarter ounce in weight and when they have dried and fluffed out, appear to be the size of a walnut.

The chicks are brooded by either parent for about three-quarters of the time during the first week and for slightly shorter periods during the second week. During hot summer days brooding is done in shady places. From time to time the family goes out to feed. Grit is sought almost immediately as well as such foods as insects, berries and seeds. The chicks deploy on all sides of the parents. Succulent berries and greens furnish the water supply. The chicks fend for themselves and are not fed by their parents.

I am indebted to Mr. Jack A. Stanford, Quail Biologist of the Missouri Conservation Commission for the following information and photographs dealing with the plumage changes in the growing quail.

FIELD KEY FOR DETERMINING QUAIL AGE

One week or less—Chicks covered with natal down, smaller than new-hatched barnyard chicks, unable to fly.

One-two weeks—Natal down predominating on head, shoulders and sides with striped and mottled juvenile feathers, first flight possible (enmoion at two weeks). Size of tail-less sparrow.

Three weeks—Birds less than one-half adult size, body fairly well covered with striped, dull juvenile plumage, head still fuzzy with natal down

Four weeks—Less than half-grown, body largely covered with striped and mottled juvenile feathers, some natal dnwn still nn head, tail one-half to inch long. About size of a tail-less robin.

Five-six weeks—One-half adult size, practically covered with dull juvenile plumage.

Seven weeks—More than half-grown but not adult; sexes indistinguishable.

Eight weeks—Approximately size of adult, still no sex differences.

Nine-ten weeks—Adult size; sexes not readily distinguisbable.

11–12 weeks—Sex not easily determined but the throat pattern hazy and the cock's black collar poorly developed.

12–14 weeks—Well-feathered but may be ragged and bob-tailed; head and throat of males rather smoky, not as white as fully-aged adult.

14–16 weeks—Fully-grown birds, easily sexed, throat and head markings distinct.

The characteristic roosting formation of bobwhites is for the members of the covey to press closely together in a circle, their tails forced up, their sides together, their heads out. This gives them maximum opportunity for flight in the event of disturbance. Bobwhites are fast fliers and use their wings from the day they are hatched. They are not capable of long sustained flight, and have no need for it since they are rapid and tireless runners. At the age of about three weeks they can fly over a five-foot fence.

When alarmed, birds in exposed places dart to cover and "freeze"; that is, they remain absolutely motionless and melt into the surrounding cover. This they do a number of times a day and stay in this position for a few seconds or several minutes at a time.

The farm producer of quail will find that the habits of the bobwhites in their natural wild state must be borne in mind when they are raised in captivity. Moreover he will find a number of problems that arise from the new environment. The worst problem is that of disease. However, methods of combating this problem have been developed, and if a policy of prevention rather than cure is followed, success may be achieved.

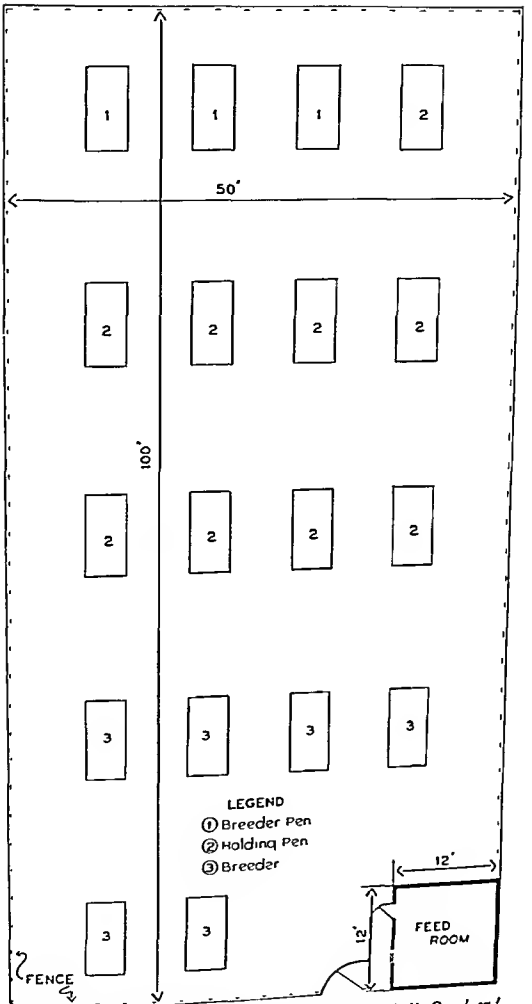
Dennis Hart and T. R. Mitchell in a publication of The Wildlife Management Institute, entitled *Quail and Pheasant Propagation* are quoted here in a description of a model plant to rear 500 quail.

A MODEL PLANT TO REAR 500 QUAIL

The photo shows the layout of a propagation plant with a capacity of 400 to 500 quail per season. A project of this size is ideal for sportsmen's clubs, farmer-sportsmen cooperatives, or small-scale commercial operations. One person can successfully operate a set-up of this size as a part-time project.

Eighteen McCarty pens* are used; three for breeding stock (12 pairs); six are equipped as brooders, and nine as growing and holding pens. The 50 by 100 foot enclosure is six feet high and constructed of poultry netting attached to posts which are placed ten or 12 feet apart. Two-inch mesh poultry netting

*The construction of a McCarty pen is described on page 149.



Model quail propagation unit. From Hart and Mitchell, *Quail and Pheasant Propagation*, Wildlife Management Institute.

may be used for the upper four feet of the fence and three-quarter-inch netting, which is buried about six inches in the ground, for the lower section. The 12 by 12 foot feed room is optional.

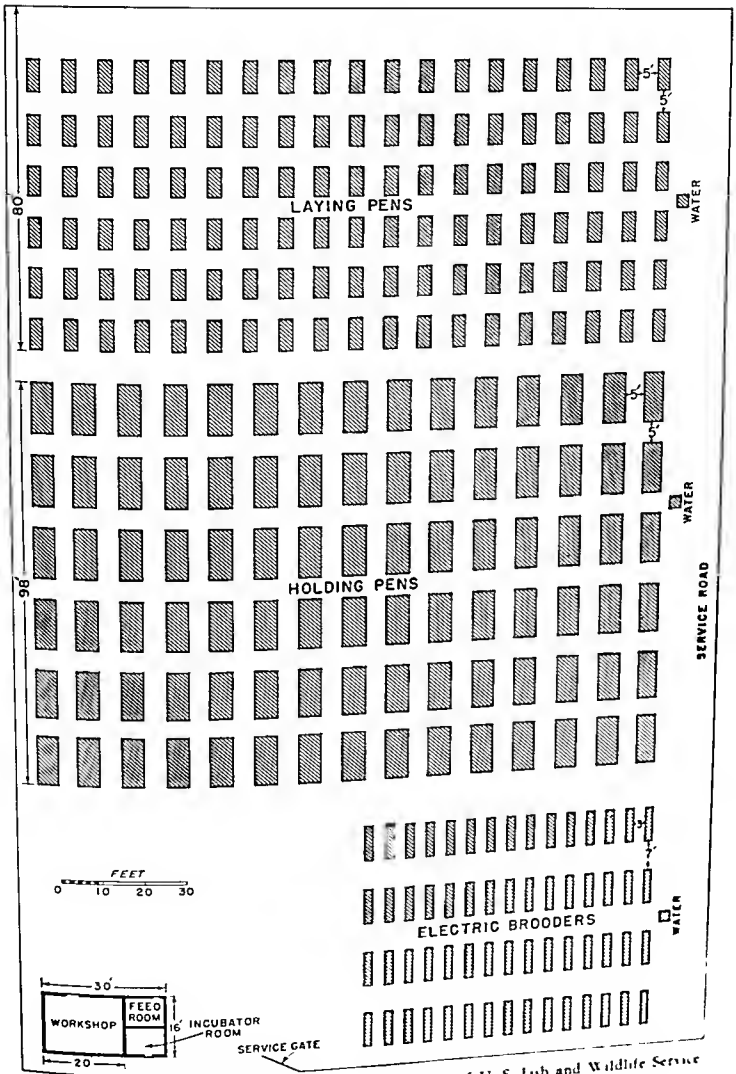
For continuous summertime operation, eggs should be set every seven days. The number of eggs produced by 12 pairs of breeders in one week will provide enough chicks to fill one brooder if properly incubated. Thus, when the sixth brooder is used, the birds in the first brooder will be six weeks of age and ready to be transferred to a holding pen. When all of the pens have been filled in this manner, the first-batched groups of quail will be old enough for liberation or disposal by other means.

If a considerable number of quail are to be held over winter all of the McCarty pens should be adapted for holding adult birds by removing partitions and brooder boxes from the pens which were used as brooders and breeding pens. Outbreaks of fighting and feather plucking often occur among groups of quail in holding pens during warm periods in winter and when the mating season approaches. To help control this, hens and cocks should be held in separate pens and, if sufficient space is available, in groups of 12 to 16 birds.

In the Fish and Wildlife Service *Bulletin 10,* Nestler and Bailey state one man can handle 40 pairs of breeding birds and their offspring without trouble, and he can expect to raise 1600 chicks from this number. One acre is enough land to raise about 4500 quail to maturity, but the breeder must be careful about the location of that acre. The quail pens should be placed on high ground, on an eastern slope away from any wet places where mosquitoes may breed. Like other game birds quail should not be reared near domestic poultry because of the danger of disease. Flies have been known to fly as far as 400 feet and may easily carry germs from the excrement of barnyard fowl, manure piles, or garbage heaps.

Even after these precautions are taken, it is advisable to raise quail off the ground (mature ones) on one-half-inch mesh hardware wire. In some sandy sections of the South, bobwhites have been successfully raised on the ground, but the wire system is safer. Single or double pens, placed above the ground at a proper height for the attendant are most usual. The whole area of the pens should be surrounded by a six-foot chicken-wire fence to keep out stray dogs, cats and other animals, because quail are easily frightened and may kill themselves by flying violently and suddenly against the ceiling of the runs.

About 3,600 quail can be held during the winter on one acre. There should be 114 breeding pens, each for one pair; 60 brooding pens and 90 holding pens, each of 40-bird capacity. The layout of this plan is shown on page 115. These figures are predicated on the assumption that the breeder will dispose of some of the stock in the fall.



Layout of quail propagation plant on one acre. Courtesy of U. S. Fish and Wildlife Service

Breeding

As a rule, bobwhites are monogamous, one male mating with a single female. The sexes are of similar size, the average weight being about six ounces. The male may be distinguished from the female by the markings of the face and throat, which are white in the male and yellowish brown in the female. As in the breeding of all livestock, the selection of large, healthy, vigorous and early-maturing birds is a prime essential. A careful study of

Because of its pugnacious tendency to pick at his brothers and sisters, this little quail on the Western-Winchester Experimental Game Farm is having its beak trimmed. The painless treatment prevents injury of young birds by one another.

laying records and fertility as well as hatchability records is important for the profitable production of quail. Two-year-old birds lay as many eggs as yearlings, but after two years, older quail are not likely to be as productive. It has generally been profitable to carry over the best yearling breeders and replace inferior stock with good producers. Both hen and cock quail should be at least 170 days old for breeding purposes.

After the breeders have been selected in the early fall, they should be put into separate pens and separated from the rest of the flock. Extra birds should be selected to replace those that may die during the winter. Pairs should be put together at least four weeks prior to the mating season.

The use of lights in laying houses to increase egg production has been

practiced for many years in the domestic hen industry. In 1934 C. J. Brill used artificial lights to induce quail to lay eggs in winter. Successive experiments by Prof. T. H. Bissonnette and A. G. Csech on pheasants increased egg laying and advanced the season by use of artificial lights.

In order to be effective the light must strike the eyes of the birds and induce an effect on the pituitary glands. A 50-watt bulb is used for every ten-foot-square area and the lights kept on until the layers have a combined natural and artificially lighted day of about 13 hours.

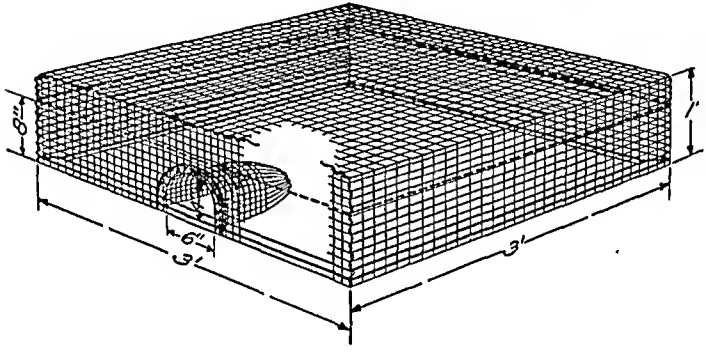
As is the practice in the breeding of all animals, new blood should be introduced into the flock from time to time to prevent excessive inbreeding. Very often it is possible to make exchanges with other breeders or to trap wild males.

Trapping Wild Quail

According to Stoddard, THE BOBWHITE QUAIL (Scribner), trapping wild quail requires painstaking methods and a fair degree of patience. One must seek a place which coveys frequent, either thickets or field borders. The presence of dust baths, fresh quail droppings, or an occasional feather, help in locating a good place to set a trap. An area of about a yard square is cleared off and a mixture of finely cracked grains is spread on the cleared area. From this area trails of grain are scattered so that they converge on the baited spot. When it is determined by the tracks of the birds and the consumption of the bait that the quail have found the grains, a trap is set on the area, with its front end propped up a foot or more. After it is found that the quail will go under the trap and scratch up the grain, the trap is lowered, and the entrance fixed so that birds can enter freely.

Buffer top standard type of quail trap. (Stoddard, *The Bobwhite Quail*, Scribner)

A trap large enough to capture a whole covey of quail is one yard square and a foot high. It is made of one half inch hardware wire, five feet long and three feet wide, nailed on a wooden-base frame. By bending down one foot at each end at right angles, we get the top and two sides. These sides are stapled to the bottom frame. Two other pieces of wire one foot by three feet are cut to form the other two sides. They are stapled at the bottom to the frame and laced with light wire to the top. A hole six inches wide at the bottom and four inches high is cut out of one side, in the shape of an arch. An entrance funnel is cut out of hardware wire, nine by ten inches in size, and the cross wires at the inside end pulled out for a distance of two

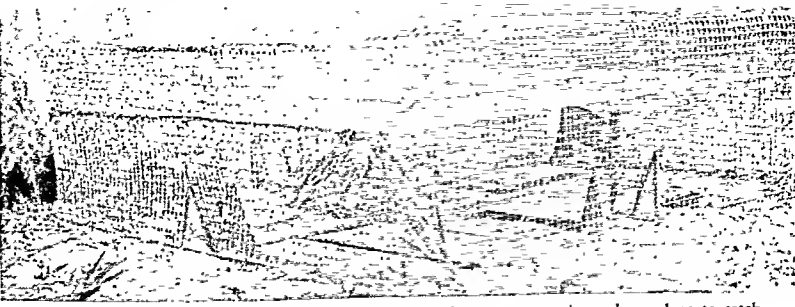


Details of construction of standard quail trap. (Stoddard, *The Bobwhite Quail*, Scribner)

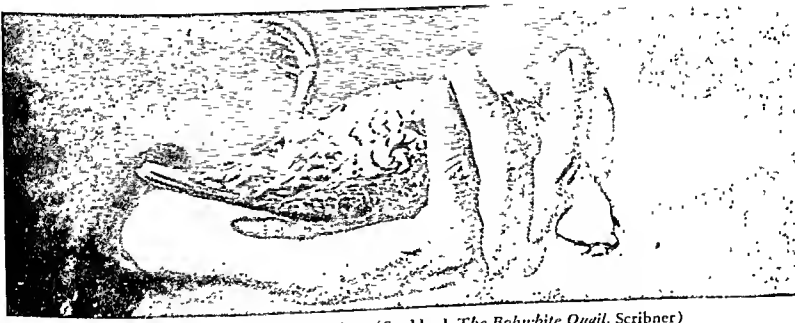
and one-half inches. The feeler wires are the longitudinal ones, which are smoothed out. The piece is then bent half round and inserted in the hole cut for it, the bottom stapled down to the frame and the rest fastened round the trap with soft wire. The sill of the frame at the entrance is then beveled down so that the quail will not have to step over it. An opening six inches square is cut in one of the rear corners and a hardwire cloth door made to fit it. This is to allow the captured quail to be driven through it into a receiving cage.

A three-foot-square buffer of one-half inch mesh cotton fish netting is hung four inches under the roof of the trap to keep captured birds from hurting themselves by flying against the roof. The trap and the buffer should be painted a dull green or black, or any color of low visibility. The trap should be camouflaged when placed in position. Long grass and bits of foliage are laid over it.

If the birds are not taken the first day, the trap should be lifted up for a



All-around cock and hen quail trap. Hen in central compartment is used as a lure to catch unmated cocks in the summer months. (Stoddard, *The Bobwhite Quail*, Scribner)



Proper hold to secure Bobwhites. (Stoddard, *The Bobwhite Quail*, Scribner)

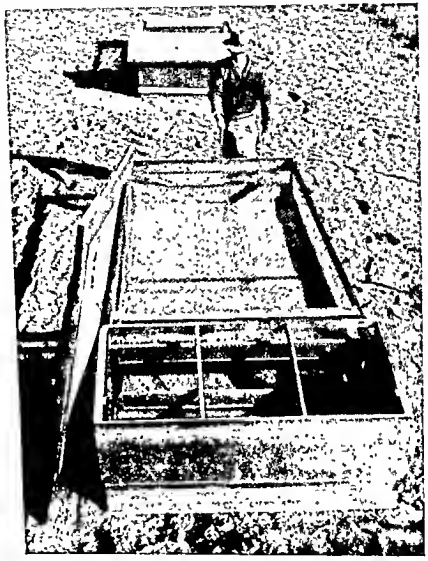
day and more finely cracked grain spread. Four visits, the last after dark, should be made to the traps daily. Quail should not be kept in the trap overnight as other animals may get in and create havoc.

When new stock is introduced, they should be isolated for three weeks before being mixed with the old stock, in order that sick birds may be detected. By purchasing eggs from other breeders, one can reduce the chance of disease.

Housing

Various types of housing are in use today. Illustrations of some of these may be found on pages 120 & 121. Two-compartment breeding pens are more economical than single compartments from the point of view of construction.

labor and handling. On some of the larger game conservation farms, especially those operated by the states, whole rows of breeding pens are built inside a large house or barn, with runs extending into the yard. When the pens are outdoors, they should be placed about five feet apart to prevent interference with mating harmony. A piece of roofing paper under the pens will catch the droppings and also keep down grass and weeds. If there is an

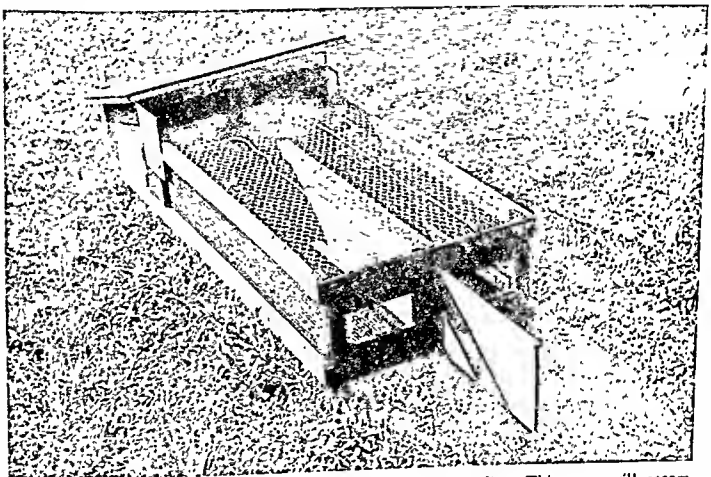


Holding pens, 40-bird capacity, for adult quail in winter, with top removed to show method of closing front exit. Courtesy of U. S. Fish and Wildlife Service

opportunity to move the pens to other areas, it would be just as well to let the droppings fall right on the grass and fertilize that portion of the ground. This ground can be cultivated the following year. By moving the pens sideways, into a position adjacent to the previously occupied space, a whole field can be evenly manured. Pens are moved every week or ten days. In each of the pens there should be a nest box, a water fountain, a small grit container, a ten inch feeder, a dusting box, a record card holder, and some receptacle for greens.

General Management

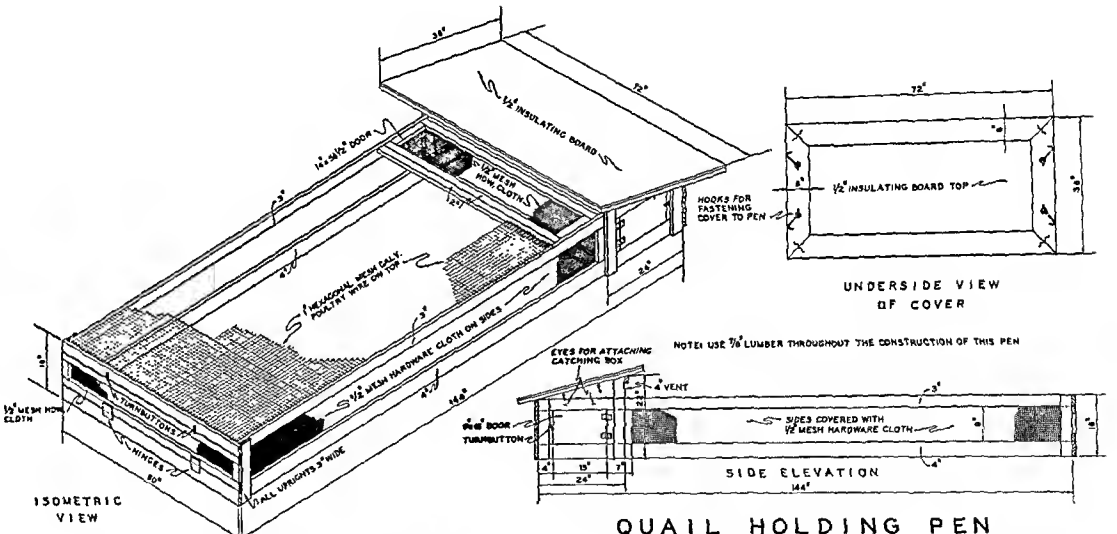
Every precaution should be taken to prevent the disturbance of quail, especially breeding pairs. Any approach to the pens should be announced by whistling or soft-spoken words. Domestic animals should never be allowed near the pens, nor should the birds be handled. Objects blown about by the wind may cause a panic among the birds and reduce egg production; therefore it is advisable to keep the entire area well policed for papers or trash.



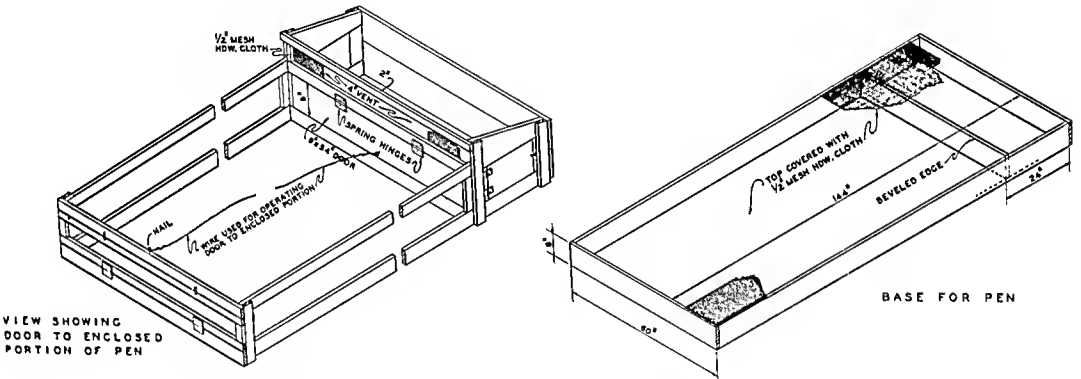
Double compartment quail laying pen with draw-board extending. This coop will accommodate a pair of laying birds or 20 individuals during the winter.
Courtesy of U. S. Fish and Wildlife Service.

Sanitation

In general, the rules for sanitation are the same as those which have been set up for all game birds. If the pens are not moved regularly, at seven to ten-day intervals, the droppings should be removed from beneath the pens. Feeding receptacles should be carefully examined and droppings which may have become mixed with the food, removed. Water fountains must be cleansed thoroughly, and, if there has been sickness, should be scoured with boiling water. The dustbox containing fine clean sand, which is used by the quail to rid their bodies of lice, should be examined at regular intervals for traces of filth. Sodium fluoride is used to rid the quail of body lice, just as has been described in the chapter on pheasants. It should be rubbed in under

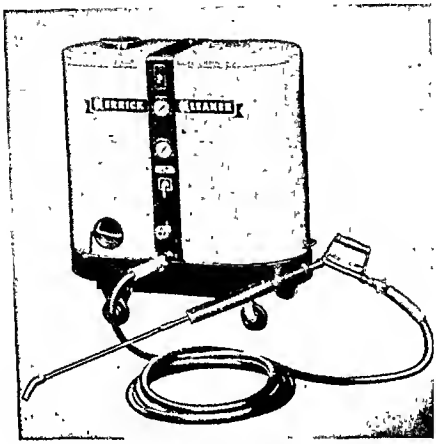


Construction details of holding pen. Courtesy of U. S. Fish and Wildlife Service.



Construction details of pen shown on page 120. Courtesy of U. S. Fish and Wildlife Service.

the wings, the legs, around the vent, on top of the head and on the breast. Care must be taken not to let it get into the eyes or nostrils.



E. H. Roth of the New Jersey State Quail Farm uses this portable steam sterilizer to disinfect coops. It is made by the Clayton Manufacturing Co. of El Monte, California.

Eggs

Fine excelsior makes good nesting material for quail. It should be placed in the nesting box and shaped in the normal deep-saucer curve of a bird's nest. It must be remembered that a captive quail remains a wild creature; therefore it is not advisable to remove the eggs daily because of the disturbing effect on the highly temperamental mother. It is better to remove eggs only once a week, even though partial incubation may be accomplished by summer heat (since germination of fertile eggs starts at 69 degrees F.). If eggs are not set each week, the first week's collection should be stored in a cool place at a temperature ranging from 50 to 55 degrees F. and turned at least once a day. As in the case of pheasants, weekly settings give better results.

Water

Water makes up approximately 56 per cent of the body weight of the quail, and about 72.5 per cent of the contents of the egg, and exceeds in the rate of turnover any other substance in the body. Consequently clean fresh water must be constantly provided.

Grit

In the state of nature, all birds pick up tiny pebbles required by the gizzard, which takes the place of teeth. The food swallowed by any bird is ground up by the pebbles in the gizzard before it passes on to the rest of the alimentary tract. A clean sharp-edge quartz (very small size) which any poultry dealer can provide, should be before the birds at all times.

Feed

Fresh greens such as cut alfalfa, lettuce and cabbage, broken up into small pieces, furnish a satisfactory supplementary diet, as well as provide some of the essential vitamins. An all-mash breeding diet should be kept in the hoppers at all times. Commercial manufacturers prepare a 23 per cent protein mixture especially for game fowl. But since the birds may pick out certain portions of the mash and leave others, it is usually necessary (especially when caring for baby quail) to supplement the mash by feeding finely ground egg yolk, which will insure an adequate supply of protein.

Breeding birds should be started on the all-mash diet one month before the breeding season. The change to this from the maintenance diet should be made gradually over a period of at least four or five days by blending the two diets together.

It would hardly be worthwhile, however, for the average game producer with a comparatively small production to buy individual feeds. He generally does better to rely on his grain dealer's special game bird or turkey mixtures.

Incubation

The general principles of incubation for all upland game birds have already been discussed, but it is desirable to point out here that for commercial operations quail eggs should be hatched in an incubator. They should never, however, be put in the same incubator with chicken or turkey eggs because of the danger of disease infectinn.

Opinions conflict concerning the position in which the eggs should be set. Some authorities say that eggs should be stood vertically with the larger end uppermost, with wads of newspaper packed at the end of each row to prevent shifting. Others lay the eggs horizontally or with their pointed ends slightly lower than their blunt ends. Both methods have been successful. The incubator should be adjusted so that the intake and exhaust openings are about one-quarter open during the first week, half-open during the second week, three-quarters open from the 15th to 19th days, completely open thereafter.

This schedule is subject to change, depending upon the type of incubator used. Three to four turnings of the eggs are sufficient for 18 days. After that, no turnings should be made. During this period a dry bulb temperature reading in a still-air incubator should be 103 degrees F. and a wet bulb reading from 89 to 91 degrees. In the agitated-air type, the reading of the dry bulb should be 99 to 100 degrees F., the wet bulb 87 to 88 degrees.

The thin shell of the quail egg makes candling easy. An electric candler makes it possible to detect infertile eggs and dead embryos at the end of one week. Infertile eggs have a very clear appearance. Dead embryos look like floating dark spots surrounded by a faint blood ring. Live embryos fill about one third of the egg. A second candling made on the 14th day will reveal a living embryo filling most of the egg, while the dead germ will fill only a small portion and show a blood ring.

On the 20th day eggs should be removed to a separate hatcher. Trays should have covers, as newly hatched quail will escape if not confined, and are often found at the bottom of the incubator instead of in the trays. The temperature in a still-air hatcher should be about 103.25 degrees F. with a wet bulb reading of 91 to 93 degrees. In an agitated-air type, the temperature should be about 99.75 degrees F. and the wet bulb reading about 88 to 90 degrees. The ventilators should be wide open. Those who wish to keep pedigree records should sort the eggs on the 20th day of incubation into pedigree baskets according to parentage. All the eggs of one female should be kept together in one or more baskets, the trays of which should be covered.

Quail chicks hatch 22½ days after the eggs are set. Unlike pheasants, they emerge from the shell so rapidly that the entire brood will ordinarily be out in less than four hours. It is considered worthwhile by many to help quail chicks break out of the shells, but this assistance should be given as gently as possible, in a warm room, and the chicks returned to the hatcher where, in 24 hours, they should be dried off. All chicks should be left in the incubator for about 24 hours after hatching, and the humidity reduced to permit quick drying. Since the young chick absorbs the remainder of the yolk of the egg from which it is hatched, no food or water is required for the first 24 to 48 hours of the bird's life.

Incubating under Bantams

The method of incubating quail eggs under bantams is the same as that already described for pheasant chicks on page 40.

Artificial Brooding

In general the brooding operation for quail is also the same as that for pheasants. The brooders should be prepared and thoroughly cleaned if they

have been used previously. Warm containers are used to carry the chicks from the incubator to the brooders. The room in which the brooders are kept should be free of drafts, and cool, with temperatures below 70 degrees F. Battery brooders, which are divided into compartments, and which have long been successfully used in raising domestic poultry, have been found to be equally adaptable in the brooding of young quail. At the rear of each compartment is a temperature heating element which should give a reading somewhere between 96 and 98 degrees F. at the floor of the compartment. A curtain should divide the compartment and the chicks placed behind the curtain near the source of heat until they learn to return to it. After a few days the baby quail will move back and forth between the heated section at the rear and the unheated section at the front, adjusting themselves to the optimum temperature, as they do under individual brooders. Quail may be kept in battery brooders for as long as ten weeks with an average of 30 sq. in. of floor space per bird, without danger of cannibalism.

Large scale brooders often use the apartment type of brooder house. These vary in style according to the ideas of the producer, but in general consist of a long shed subdivided into individual rooms built high enough for an attendant to walk around in. The upper part of the south side is glassed in. The lower part is connected with outside runs. These runs are built on a concrete slab and consist of a framework on which is tacked ordinary fly screening. The floor is covered with a litter of ground corn cobs or sand. In some cases the outside runs have wire bottoms and are above the ground level.

The apartment type of brooder lends itself best to the new radiant heating method, where copper pipes are put into the floor and hot water run through them. This method is as yet new and has not been widely adopted, but the great success of radiant heating in homes will undoubtedly influence the construction of such systems in future apartment brooder houses. The even spread of heat all over the floor and the economy of operation make this type of heating highly desirable. It is even claimed by some raisers of domestic poultry that radiant heating has a deterrent effect on coccidiosis.

The beginner would do well to use individual colony brooders until he is fully experienced. The colony brooder is a cheaper method of getting started since it involves a smaller investment in buildings.

Before we consider this next step, it may be well to mention that leg bands, the small kind such as are used for canaries, may be put on at hatching time but must be replaced with larger aluminum bands at the end of three weeks. Otherwise the growth of the leg inside the narrow band will result in the crippling of the young quail. The purpose of the leg band, which always bears a number, is to aid in keeping pedigree records. Trout tags inserted in the wing webs may also be used.

In smaller operations, where colony brooders are used, the chicks are taken directly from the incubator to the colony brooders. Again, as with pheasants, they are confined to the section which is heated for the first few days, then gradually allowed the run of the brooder. If the weather is warm, the birds are permitted into the section of the brooder which is exposed to the sun, starting with a few hours on the third day and the length of time they are exposed in the open air is increased as the birds get older. They should be confined to the heated compartment at night and during stormy weather.

The temperature for the first week should be about 97 degrees F. and should be reduced at the rate of five degrees each week with some exception made if the weather should suddenly get cold. Depending upon latitude and temperature, birds should be moved to holding pens after five weeks.

In raising game birds of any kind, it is well to harden them as soon as possible so that they can face the conditions of the range with impunity when they are released. One of the greatest difficulties in restocking our diminishing game supply is the fact that domestically raised birds are not sufficiently toughened to fend for themselves. It is because of this that the breeder should use his judgment in the progressive steps of rearing. Ideally, the birds should be put on their own as soon as possible, but the delimiting factors such as inclement weather and sudden cold snaps must be reckoned with in pushing the bird into a simulated wild state.

In the brooding of quail, the same sanitary precautions must be exercised as in the raising of any young stock. Fresh water must be supplied constantly, utensils kept clean, feeding pans scrupulously watched for droppings mixed with the food. The droppings must be scraped out of the trays at least once a day.

Feeding

A mash diet is kept before the baby quail constantly from the time they leave the incubator through the 12th week.

Coarse sand in a glass coaster such as set under the legs of furniture should be provided in lieu of grit. Quail chicks need never receive anything in the way of feed except mash and water. The old fashioned ideas about feeding them grated egg yolks, grated greens, and grated fresh peaches are out-moded.

About one pound of food is required to raise a quail to the age of ten weeks. Young quail should be watched very carefully their first day

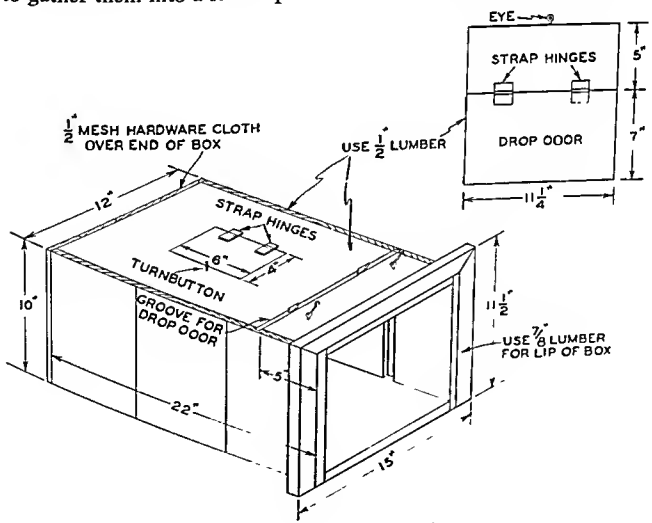
in the brooder to make certain that they find the food. Dropping small particles on a cardboard which leads to the feed hoppers is one way of showing the chicks the source of food. Feeding young quail with an eye dropper containing milk, when they do not seem to learn where the food is, is a method practiced by some breeders. Particles of green leaves in the water fountains may also help them to get started. Hardboiled eggs may be mixed with the mash or with plain rolled oats to form a moist, crumbly mass and fed either separately or on top of the dry mash. This should be done in quantities which will be cleaned up by the birds in about two hours.

Changing the Quail from Brooders to Holding Pens

There are many types of holding pens, some designed by commercial breeders and others by conservation departments of various states. The one given here is designed by the Fish and Wildlife Service of the United States Department of the Interior.

Catching Box

A catching box is used to transport quail from one type of pen to another, or to gather them into a small space for careful examination. It is hooked to



Construction details of catching box.

an opening on any pen from which the birds are to be removed. The quail are driven into the catching box which has a drop door. This door is dropped when the quail are safely in the box. The construction details of this box are shown on page 129.

Winter Management of Non-breeding Stock

Fresh water and feeds should be kept before the birds at all times and the droppings cleaned from under the pens at least once a month. Where the climate is warm, birds may be left out during the day except during cold spells. In the North birds should be shut in the shelters every night. Driving them in should be done before sunset, as they are hard to manage after they have settled down for the night. About 40 birds may be kept in one holding pen. When the mating season approaches, the bobwhites become restless and begin to fight. This is the time to dispose of all stock except breeders.

Males and females can be selected at random and put together in breeding pens. It is a good idea to keep a few surplus birds over the amount of breeders required, so that if a male and female prove incompatible, they can be re-mated. The males and females kept for reserve stock should be in separate quarters.

The feed requirements for growing stock are different from those of adult birds. The amount of protein can be reduced to about 12 per cent for maintenance diets. At the end of the sixth week of growth, the 12 per cent diet can be fed in equal quantities with the 30 per cent. At the end of 12 weeks, the maintenance diet alone can be used.

RATIONS FOR BOBWHITE QUAIL

Recommended by Woodrow W. Bailey and Ralph B. Nestler
(Fish and Wildlife Service—*Bulletin No. 10*)

Starting:

All-Mash Growing Diet (28 per cent protein)
(To be fed from hatching time to end of 12 weeks)

	Parts by Weight
Yellow corn, finely ground	24.0
Millet, ground	10.0
Alfalfa leaf meal, dehydrated	5.0
Soybean oil meal, high-temperature processed	42.0
Buttermilk, dried	16.0
Bonemeal, special steamed	0.9
Limestone, high-calcium pulverized	0.9
Salt mixture	1.0
Vitamin A and D feeding oil fortified	0.3
Total	100.1

Maintenance:

All-Mash Maintenance Diet (12 per cent protein)

(To be fed in connection with growing diet from the beginning of the sixth week; fed alone after the 12th week, and to be changed to breeding diet one month before breeding season)

	Parts by Weight
Yellow corn, ground	85.6
Alfalfa leaf meal, dehydrated	5.0
Soybean oil meal, high-temperature processed	7.0
Bonemeal, special steamed	1.2
Salt mixture	1.0
Vitamin A and D feeding oil fortified	0.2
Total	100.0

Breeding:

	Parts by Weight
Yellow corn, ground	25.0
Wheat middlings, standard	10.0
Alfalfa leaf meal, dehydrated	10.0
Soybean oil meal, high-temperature processed	36.0
Buttermilk, dried	12.0
Bonemeal, special steamed	3.0
Limestone, high-calcium pulverized	2.5
Salt mixture	1.0
Vitamin A and D feeding oil fortified	.5
Total	100.0

Recommended by August Bade, Chief of the Bureau of Game Farms, California

Growing Scratch Grain for Young Partridges and Quail

Large yellow millet	8%
Small yellow millet	8%
Red millet	8%
Water grass	8%
Dark milo	8%
Dark gyp	8%
Cracked wheat	16%
Cracked rice	8%
Cracked small green peas	20%
Cracked oat groats	8%

Scratch Grain for Pheasants, Partridges and Quail

Hard red wheat	50%
Gyp corn	20%
Red milo	10%
White milo	10%
Buckwheat	10%

The author is grateful to Dr. James T. Baldini of the E. I. Dupont De Nemours Company for reading this chapter on quail and making some very valuable suggestions. Dr. Baldini wrote his Ph.D. thesis at [illegible] Requirements of the Captive

14

The Chukor (Chukar) Partridge

Alectoris graeca (Meisner)

Description

Length 15 inches. Upper parts brownish-olive to ashy, tinged across the shoulders and sometimes also the crown with vinous-red; sides of the crown gray bordered by a buff line over the eye; outer scapulars pure ashy with broad rufous edges; wing-quills brown partly edged with buff; tail ashy-drab, the terminal halves of the outer feathers pale chestnut; ear-covers dull chestnut, a black band across the forehead through each eye and continued behind the eye and round the throat as a gorget; the enclosed area buffy-white with a small black spot on the chin and one each side by the gape; breast ashy slightly tinged with brown and washed on the sides with vinous; remainder of lower plumage buff, darkening towards the tail, the flanks heavily barred with black and chestnut.

Iris brown, yellowish or orange; bill and legs red, claws brown. Weight, male one pound, three ounces to one pound, eleven ounces, female 13 to 19 ounces.

The male has a short blunt spur above the hind toe.

Field Identification

Hill ranges bordering northwestern India. In parties on open hillsides. An ashy and buff partridge at once distinguished by the black loop on the face and throat and by the beautiful barring of the flanks.

Distribution

Under the name of Greek partridge this bird has a wide distribution in Europe and in western and central Asia, and it has been divided into a number

of races. We are concerned only with the form *A.g. Chukar,* so well known to sportsmen by its vernacular name of Chukor, and the paler Baluchistan and the Kirthar Range dividing it from Sind and also in the Salt Range. The former is found in the Himalayas as far east as Nepal. It is found from 1000 to 15,000 feet.

The Chukor chiefly differs from the well-known French partridge *(Alectoris-rufa)* of Europe in lacking the fringe of black spots outside the gorget band, and in having two black bands instead of one of the flank-feathers.

In the Salt Range and the lower hills west of the Indus the See-See *(Ammoperdix griseogularis),* a small sandy-colored partridge with striking head markings and flank-feathers in the male, is found on the same ground as the Chukor.

Sportsmen after big game in the Himalayas above tree-level soon make the acquaintance of the noisy Ram-Chukor or Snow Cock *(Tetraogallus himalayensis),* a big partridge-like bird found in coveys on the alpine pastures. Weight five to six pounds.

Habits, etc.

The Chukor varies a good deal in its choice of ground, provided that it is on a hillside and free from trees, other than juniper. On the frontier hills it is found on the hottest and most barren hillsides, which fairly justify the native saying that the bird feeds on stones. In the Himalayas it is equally at home on the open grassy hillsides in the low hot valleys, on stony screes covered with a light growth of barberry bushes, and amongst the snows at 12,000 or 15,000 feet—a diversity of range unusual amongst birds. Incessant damp and heavy rainfall and forest, however, it cannot stand.

Except when actually breeding they are found in coveys; these in their origin are family parties consisting of a pair of old birds with their last brood; but as the winter progresses the coveys pack in suitable localities so that 30 to 50 birds may be found together until the spring breaks them up into pairs. They live and feed on the ground, and when approached usually run for some distance uphill before taking wing. The flight is very strong and fast, several wing-beats followed by a glide, and the coveys sweep round the contours of the hills or across small valleys for some distance before settling. They then generally scatter a little and squat and are found again with difficulty.

The call is a loud ringing chuck-chuckor uttered in various tones. This call and the pugnacious nature of the bird and the ease with which it is tamed render it a favorable cage-bird in northwestern India.

The food of the chukar consists largely of grain and seeds as well as roots, green shoots and leaves and a variety of insects and larvae.

The breeding season is from April to August, early at low altitudes and late

in the higher portions of the bird's range. The nest is a hollow scraped in the ground under the shelter of a stone or a tuft of herbage; it is lined with grass, dry leaves and other rubbish, usually somewhat sparsely.

The clutch varies from five to 14 eggs, but the usual number of eggs is from eight to 12. The egg is a rather pointed oval of a close and hard texture with a fair amount of gloss. The ground-color is pale yellowish or greyish-stone, freckled sparsely all over with pale reddish-brown or pinkish-purple, a few of the freckles becoming small blotches.

In size the eggs average 1.68 by 1.25 inches. Above excerpted from POPULAR HANDBOOK OF INDIAN BIRDS by Whistler.

Chukars in captivity are prolific egg layers, producing in one season from 106 to 136 eggs with an exceptionally high percentage of fertility. While a cock bird will mate with several hens, best results have been obtained in mated pairs. Mating begins in the early spring in the more northerly states.

At the Wisconsin Game Conservation Station chukar eggs are incubated at a temperatute of 99½ degrees with an 83 per cent humidity. Eggs are transferred on the 18th day from forced-draft machines to still-air incubators. Here the temperature is held at 103 degrees.

Artificial brooding is done in small brooder houses equipped with electric brooders. Cottonseed hulls and shavings are used for litter. A cardboard guard 12 inches high around the hover for the first few days keeps the chicks near to the heat source, which should be maintained at 100 degrees floor level. White cloth sacks are used on the floor inside the guard as a surface for feeding until the chicks get accustomed to eating from hoppers. As is the case with other upland game birds, a 26 to 30 per cent protein mash is fed until growing feeds with a lower protein content are fed at the age of five weeks.

During the first week pebbles are kept in the drinking fountains to prevent the young chicks from drowning. Chopped greens are fed after the sixth day until they are given the use of the runs.

The Wisconsin Station recommends a brooder house measuring 12 feet long, ten feet wide, and six feet high in front and four feet high in the rear. The house is partitioned in the center to accommodate two electric canopy-type heating units, 26 inches wide and 30 inches long. One hundred chicks are placed in each unit. The house is insulated, and ventilation is controlled from the top, front and rear of the building.

In conjunction with the brooder house, two sun porches measuring six feet wide, 12 feet long, and two feet high are used. The bottom is covered with ½-inch hardware cloth. The sides of the porch are boarded up about six inches, and the remainder of the pen is covered with one-inch mesh wire. It is advisable to cover half the porch to provide shade.

A covered run 50 feet wide and 60 feet long, partitioned in the center,

should also be provided. The run should previously have been planted to alfalfa or rape to provide shade and green food.

On the tenth to 12th day, weather permitting, the chicks are allowed out on the wire porch. They are driven in each night or sooner if the weather is inclement. At the age of about three weeks they are allowed into the large run, and then driven back on to the porch each night. At six weeks the birds are transferred back to the small wire bottom breeding pens which were previously used as brooder houses. The electric brooder is removed. No more than ten birds are confined in a single run and only those from the same run. This prevents fighting.

During the period that the chukars are allowed full range in the pen, feeding and watering should be done from the outside. A sectioned hopper with compartments for mash, grain, grit and oystershells is placed on the outside and a horizontal slot cut into the base board of the pen. This extends as long as the feed hopper. The slot should be at an elevation so that the birds can stick their heads through and get at the feed. The section of the hopper used for grain and mash should be much longer than the grit and oystershell sections. Next to the feed hopper a water pan is placed and above it a vertical slot so that the chukars can tip back their heads when drinking. Inside of the pen itself a small shelter should be built in one of the corners. The Wisconsin Station recommends a shelter about two feet wide by three feet long, hinged to one side of the pen, so that it may be lifted easily and the eggs laid beneath it removed. If the pens are used to hold breeding stock in the winter, brush or cornstalk shocks are provided to give additional shelter.

As in the case of other upland game birds, breeding pairs should be placed in their pens at least a month before breeding time. Breeding begins at the end of March in regions as far apart as Missouri and Wisconsin. The pens should be moved as the ground cover begins to disappear, first for purposes of disease prevention, and secondly because fresh green food is made available.

Eggs should be collected with as little disturbance of the chukars as possible, once a day in cool weather and twice a day in very hot weather. When collected, the eggs should be put in a cool cellar and placed small end down in a tray of sand or similar material. The eggs should be tilted in one direction one day and in the opposite the next.

For hatching and rearing with bantams, follow the directions given for pheasants. However, since chukar eggs are smaller, more eggs can be put under the bantam.

15

The Hungarian Partridge

THE HUNGARIAN OR EUROPEAN GRAY PARTRIDGE (*PERDIX PERDIX perdix*) is a native of central and southeastern Europe and the British Isles. Various attempts have been made to introduce it into this country from early times and only of late have some of these attempts been successful. The partridge is intermediate in size between the bobwhite quail and the pinnated grouse. Unlike the bobwhite, which sometimes perches in trees or on posts, the partridge is almost exclusively a ground dweller. It is stronger of wing than a bobwhite, but a single flight is seldom made for more than a quarter of a mile. When flushed partridges rise with a burst of extremely rapid, noisy wing beats, usually accompanied by a series of treble "keep" calls. The flight is usually in a straight line, but may end in a swing to right or left just before alighting.

The adult males may be distinguished from the adult females by the brighter yellowish chestnut on the head and throat, the grayer neck, and the dark brown "horseshoe mark" on the lower breast. The wing coverts have buff cross-bars in the female, whereas there is only a longitudinal stripe in the male. During the mating season the upright bearing and aggressiveness of the male are in decided contrast to the timid habits of the female. The female of the pair leads the way while the male follows and keeps guard.

The Hungarian partridge is a bird of the temperate zone and thrives best where corn and small grains are grown. It has been found that in regions of heavy rainfall at hatching periods the mortality is high. Partridges are not adapted to hot, dry climates. They prefer a cover afforded by crops and crop residues, which afford ample protection for both adults and young, and they are therefore less dependent upon natural cover than pheasants or bobwhites.

Seasonal Habits

The seasonal habits of the partridge are influenced both by the need of the birds at different times of the year and by agricultural activities. In the spring, following mating, the pairs spread out from their winter range and occupy all the available types of habitat, feeding in stubble fields and feeding and hiding in standing cornfields. During the late spring period, the growing grain and hay fields provide cover for the adults and the newly hatched young. While the females are incubating, males use whatever shelter is available near the nest, such as hedges or growing crops. Adults dust and feed along roads during late spring and in summer the flocks of young are brought to the dirt roads for the same purposes.

In summer, as the hay and grain fields are cut, the flocks spend much time feeding on insects and seeds in the stubble and hay fields and begin to use the cornfields for cover. During the fall period the majority of the flocks seek stubble and uncut cornfields for feeding and resting. Through the winter period they are found almost entirely in small-grain stubble and cornfields, although they go to winter wheat and hay fields for green food.

Male Hungarian partridge. The "horseshoe" on the breast and the solid brown head identify the male from the front. Courtesy of the Michigan Department of Conservation.

Mating

Mating occurs during the late winter and the pairs can be distinguished by their association together, although they live in coveys. Mating usually follows a series of days when the temperature rises well above freezing. If warm weather persists, practically all the birds become separated into pairs within two weeks. During cold weather and storms paired birds reband into small groups.

Calling begins early in the mating season when "talking" may be heard

among members of coveys in the field. Fighting is common among males during the spring months, when the mated males vigorously combat unmated rivals that approach their mates.

Nesting

The earliest nests are begun in the latter part of April. At this time stubble fields, fence rows, woodlots, and roadsides, especially where dead herbaceous growths and grasses remain from last year, provide the only cover for nests. Areas with scattered weeds or berry vines are more often selected than thick shrubby growths. More nest building comes in early May when hay and winter wheat have grown sufficiently to provide cover. The Hungarian partridge nests on the ground. When fields are used for nesting, it shows a marked preference for the borders. The nest is usually made in a shallow, cuplike depression, which is excavated and smoothed by the bird. Although both birds have been found at nests during the early stages of nest construction, it is not known whether one or both members of the pair take part in the work. Abandonment of nests is common. This happens before many eggs are laid. Later in the season, especially if the first nest has been broken up during laying, only a small depression, barely large enough for an egg or two, is made. Then the hole is progressively enlarged as egg laying continues. The average size of the holes for completed nests is about seven and a quarter inches wide by two inches deep.

Female Hungarian partridge. The grayish pattern of the head, throat, and neck, together with the partial or complete absence of the "horseshoe," are aids in identifying the female. Courtesy of the Michigan Department of Conservation.

The nest is always lined with vegetable fibers arranged in two layers. The outer layer is made up of coarse material, such as dead weed stems, straw, the outer woody fibers of cornstalks, fine twigs, dead grass and often body feathers. The inner layer is composed of softer, finer materials such as feathers and the leaves and stems of soft grasses. Material is often added to the inner

lining as incubation proceeds. Runways or tunnels through the grass approaching the nest are often found in grassy sites and may vary from a few inches to seven feet in length. Often dead grass is used in concealing the nest.

Egg Laying

The first eggs are usually laid in the latter part of April but the majority of clutches are begun during the first week in May. Old birds start nesting a week before young birds.

The female covers the eggs during the laying period with a layer of dead grass or grain leaves. The eggs lie point down during incubation. One or more pheasant eggs are sometimes found in partridge nests. The egg of the Hungarian partridge varies from pale olive and bluish tints to dark olive brown in color. Eggs average about 1.40 inches by 1.04 inches in size. The number of eggs in a clutch may vary from five to 25 with an average of sixteen. The average size of late clutches is smaller than those laid earlier in the season.

Incubation

Only the female incubates the eggs. Within a day or two after incubation starts, she becomes very broody and usually refuses to desert her nest except for some unusual disturbance. The female leaves the nest in the early morning and late afternoon for an extended period of dusting and feeding. She also leaves for short periods during the day. As hatching time approaches, she leaves the nest only for very short periods, and after hatching begins she stays continually on the nest until the young have emerged.

During the incubation period, if cover permits, the male remains in the vicinity of the nest, usually not more than 100 feet away. At intervals during the day he gives a subdued call, apparently to reassure the female of his presence. At the time of hatching, the male takes his place at the nest and is ready to help with the care of the young when they leave the nest. The incubation period is 24 days.

The male bird acts as a sentinel and takes the initiative in directing the movement of the flock. Sometimes when the family is approached, one of the parents, usually the male, will fly off alone, apparently as a decoy. When parents with tiny young are approached by a dog in the field, they usually use first the broken wing ruse with excited screaming and ordinarily succeed in decoying the dog some distance from the young before taking wing. Then both birds usually fly away near the ground, keeping together just out of the dog's reach. Until the young have developed their powers of flight they are thus guarded closely by both parents and kept in the cover of grain fields and hay fields much of the time.

Adult males weigh about 13½ ounces and the females about 13.2 ounces. The parents and the young remain together until the coveys pair and break up the following winter. The cruising range of coveys is somewhere between an eighth to a fifth of a mile and some coveys may, unless flushed, seldom leave a ten-acre stubble field for several weeks when food is available. Water requirements are not great. Partridges drink dew. Both young and adult birds appear to survive on succulent vegetation and insects during the short periods in which there is no dew fall.

The Hungarian partridge is better adapted to conditions existing in intensively farmed areas than either our native game birds or the introduced pheasant. The management practices such as leaving unharvested grain in the fields in the winter, providing hedgerows, and spreading manure daily are the same as for other game birds. These partridges offer a splendid opportunity to stock fields and may provide a real substitute for game birds that fail to survive when released.

Domestic production follows along the same general lines as those used for chukars and quail. It must be remembered however that chukars and Hungarian partridges are larger than quail and modifications must be made in determining the number of eggs to be used in an incubator, the number of chicks in a brooder, and the number of adults to be kept in a pen.

Mr. Walter F. Van Dien, Biologist of the State of Michigan Department of Conservation, and Mr. H. D. Ruhl, Chief of the Game Division of the State of Michigan Department of Conservation, have been kind enough to place at my disposal the results of their experiences in the propagation of Hungarian partridges for a number of years. The following is based entirely upon the results of their experimentation.

Breeding Pens

Some Hungarian partridges have been raised in the standard type pheasant breeding pens which rest on the ground. However, more success has been achieved by using elevated pens. These pens have a yard 8 × 3 feet, and 2½ feet high, attached to a coop which is left open on the side toward the wire yard. It is 40 × 36 inches and 22 inches from floor to roof. The bottom of the entire pen is cloth and the whole affair is elevated. It rests on 6 legs, 8 inches above the ground. Wire of 18-gauge and 1-inch mesh is used to cover the top, end and sides. Two doors hinged at the middle of the top of the pen, open from each end and allow access to the entire interior from either direction. Access to the coop is through a door in the sloped roof; here are kept feed, water and grit in pans. A nest box 12 inches high, wide and long is included for the nesting period, and is placed in one corner of the coop away from the feed pans. The dusting box in the corner of the yard is

10 inches deep and 12 inches square. This type of pen needs to be moved only once or twice during the breeding season to allow the attendant to cut the grass and weeds growing underneath.

Egg Gathering

The care of the eggs prior to their being incubated is of great importance. They should be collected at least every second day during the season and carried to the storage room in a container lined with some soft material such as shavings, sawdust, chaff, or peatmoss. Each egg is numbered to correspond with the number of the pen from which it was gatbered. This is for use in selection of breeders.

The eggs are stored in a cool dark room and are turned at least once each day. They are never held longer than ten days before tbey are incubated since hatchability is known to decrease with the increase in tbe age of all eggs. All eggs which are cracked, or of thin or twisted sbell, or of abnormal formation, are discarded.

Electric Incubation

Eggs set in forced-draft machines seem to incubate better tban in still-air types. The egg is placed with the large end up in the incubator trays because of the location of the heads of the embryos near the air-cells. The eggs are turned after the first 12 hours usually by the means of handles on the outside of the machines, attacbed to the trays inside. This turning is repeated every 4 hours a day beginning at 6:30 a.m. and continuing until 10:30 p.m. Turning the eggs continues until the night of the 20th day. At no time except during the candling on the 8th, 14th and on the morning of the 20th day are the eggs ever handled. At candling periods, the infertile eggs and those containing dead embryos are removed from the trays and records kept of these discards.

In forced-draft machines the eggs are usually kept at a temperature of 99¾° F. However, if the weather is very cold this may be increased a quarter of a degree, and if very hot, lowered the same amount. Where still-air incubators are used the temperature is held at 102 to 103½° during the period of incubation.

In the forced-draft incubators the eggs are transferred at the last candling time, to hatching trays in the still-air type. After this they are allowed to remain without being turned. Those incubated in the still-air type are candled for the last time during the morning of the 20th day and then they have no more mechanical turnings performed.

Hungarian partridge eggs usually begin to pip on the evening of the 22nd day and begin hatching about 24 hours later. At pipping time the humidity

must be raised. This is accomplished by sprinkling the eggs by means of a hose and nozzle attached to a hot water heater and a very fine mist of hot water is created.

Later in the hatching period the spraying is repeated to prevent the chicks sticking to the insides of their shells.

When the chicks are about 24 hours old, they are taken from the hatcher and examined for cripples, malformation, and wet individuals. The wet ones, if otherwise normal, are returned to dry out thoroughly but the discards are destroyed. The dried and fluffed-out chicks are removed in dry warm boxes to the brooders.

In artificial incubation, fertility averages have been found as high as 86.4%.

Electric Brooding

The chicks are placed under a hover set on a floor of quarter-inch hardware cloth on frames approximately 2 × 6 feet in dimension. This sectioned flooring is built to facilitate its removal when droppings begin to collect in the mesh of the wire. Under this wire flooring, litter is placed. On the top of this litter a covering of burlap bags for collecting the droppings and absorbing the moisture from them is placed. Around the edges of the hover area are panels of one-half inch hardware cloth used for confining the chicks to the area immediately surrounding the hover at the source of heat. The temperature at the level of the chicks' backs is set at 95 to 100° F. under the hover, but if the temperature out-of-doors is very low, it may be increased to 105°. If it is very warm outside, the temperature under the hover is maintained at the 95° level.

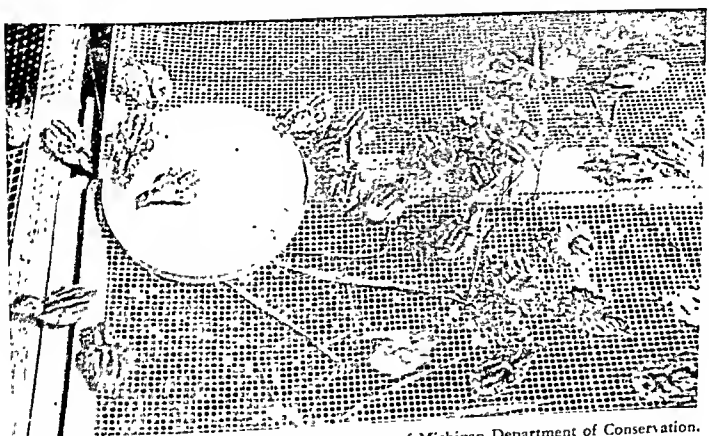
In order to prevent a too sudden change in temperature for the birds at the time the heat is finally turned off, the temperature is lowered one degree each morning after the first week. In this manner the heat under the hover is down to about 89° F. by the end of the 14th day, 82° by the end of the third week, and 75° at the beginning of the fifth week. It is maintained at this level until the birds are through their sixth week at which time it is discontinued entirely. Eliminating the source of artificial heat in this manner begins the hardening process which may continue for as long as two weeks before the birds are released in the field, or turned into the farm's range fields or range pens.

When the chicks are first placed in the brooder house, a half-pint can with a hole near the rim is filled with water and placed inverted in a petri dish. This type of water fount prevents too much wetting and occasional drowning. The water founts are thoroughly washed each day.

The usual starter feeds with a high protein content are set before the birds

in small containers. Pieces of one-quarter inch hardware cloth are cut to fit the metal pans exactly and placed over the feed. This saves waste of food and contamination.

During the first week fine-cut alfalfa, clover, lettuce, or other fresh greens are added on top of the mash and a pan of grit and fine oystershells is made available. In addition a pan of fine clean sand sprinkled with charcoal, is given to the chicks. During the first three days paper plates may be used; these are disposed of at the end of each day. They are not used after the third day if the chicks have learned to eat well.



Hungarian partridge chicks two days old. Courtesy of Michigan Department of Conservation.

It is imperative that the attendant spend a great deal of time the first few days teaching the chicks to eat. He should also watch out for nose and eye picking as well as trying to prevent early starvation. The attendant should use a soft clucking, or tapping with his fingers on a piece of wood, to attract the birds to the feed pans.

On the morning of the fourth day the chicks are allowed access to the sun porches where feed trays, water founts, greens, and sand are placed. In two or three days depending on the weather, they are allowed to forage out on the ground away from the porch. Here they should be allowed to roam only on good clean ground, preferably with heavy green cover. The cover in the immediate vicinity of the brooder porch should be cut so that they do not become lost the first week.

Because of their small size, Hungarian chicks can crawl through any wire

larger than one-half inch hardware cloth. For this reason the yards are surrounded or reinforced on the bottoms by stretches of one-half inch hardware cloth.

Only a small portion of the yard is used at first; the size of their range may be increased as the chicks grow older. By the end of the fifth week, they are allowed access to the entire pen. Usually a single yard 150 × 24 feet adjoins each brooder house at the end of the brooder porch. If two yards are to be used in order to increase the opportunity to exchange ranges from time to time, they are only 14 feet wide. In the former case, the birds should be removed from their brooder area to the range by the end of the seventh or eighth week depending on the weather and on their development.

Removing Flight Feathers

To insure the birds remaining inside their pens, flight feathers must be pulled from one wing. The first pulling is done on the 14th to 16th day and then at twenty-day intervals until the chicks are about 16 weeks of age. Of course, this is unnecessary where the birds are to be released in a natural covert or held in covered pens. Constant vigilance against picking, diarrhea, cannibalism and other troubles must be observed. As soon as the chicks use the porches to any extent, all feed and water utensils are placed there. After the yards are in use, feeding chopped greens and sand is unnecessary.

By the end of the first week, quart-sized commercial water founts may be substituted for the petri dishes and cans, and feed troughs 24 inches long should replace the flat feed pans. These feed troughs are equipped with spindles across the tops so that birds fail in any attempt to stand in or roost over the feed.

By the end of the first week, the floors under the hovers may be removed and also the cloths under the frames of the wire. The chicks then are allowed access to clean fresh litter. In a day or two they may have the wire panels removed and may use the entire brooder house provided they have learned to go under the hover to brood. The litter in the house is turned over and aired once each week until the end of the sixth week. At this time it may need to be replaced if the birds are to be held there any longer.

When the chicks are in their third week, fine chick grains are sprinkled over their mash and as soon as they learn to eat this feed, it is added to their menu in trayfuls. Fresh clean water and oystershells are also made available to them.

Shavings, alfalfa chaff, finely ground sugar cane, very coarse sawdust and almost any other standard form of litter may be used.

Natural Mother Method of Incubating

In this method, the mother Hungarian partridge is allowed to continue her laying until such time as she shows indications of wanting to incubate. Where past performances indicate that she is an ideal mother and has hatched good families, her eggs may be allowed to remain in the nest after a certain number have been produced. Eggs laid by other hens may also be put in the nest, up to about 18 eggs.

The male should be removed from his mate at the time of incubation because of his tendency to fight the attendant or jump on top of the hen in his efforts to get away from him.

When the chicks are hatched, they should be lifted out gently and carried to a brooding pen on which there is a wire floor covered with hay or grass so that the little chicks do not fall down as they try to walk. The mother hen teaches the chicks to eat and drink and also provides them the necessary heat.

Experience has shown that while this method of hatching and rearing takes more labor, the percentage reared per season is higher than when the eggs are placed under a bantam hen or in an incubator.

The natural method induces better feathering and obviates the necessity for feather pulling to prevent flight.

It is not good practice to allow more than twelve chicks to stay in the rearing pen after they are eight weeks old.

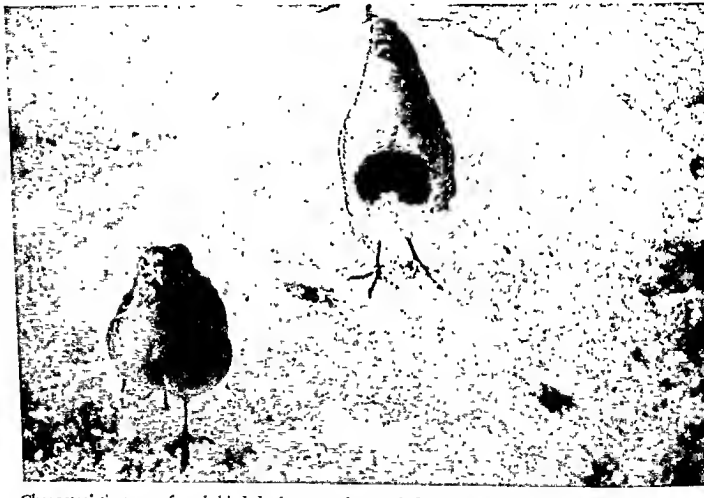
Confinement Over the Winter

Probably not over 500 adult birds should be held on each acre of land during the period July to October, and their winter quarters should be clean fresh ground devoid of any possible contamination. At the time of snow, a covered corral about 300 feet long, 35 feet wide, and 8 feet high is sufficient to accommodate from 200 to 250 head. A large inverted-V shelter is constructed, with a framework of wide boards, covered with a thick layer of corn stalks. It is made to face north-south and openings at each end allow the birds access both ways. The northern end has an opening about a foot square while the southern end is left entirely open.

In the holding areas, the birds are retained until such time in spring as circumstances permit filling the breeding areas. This largely depends on the weather and the type of mating procedure to be inaugurated. It is not difficult to maintain excellent health among the birds during this period; grains, game-bird mash, greens from local grocery stores, oystershells and fresh water are supplied only in such quantities as to be consumed from one day to another. The feeding utensils are placed under small sloping shelter boards for protection from the weather.

Mating the Breeder Pairs

Hungarian partridge are normally monogamous in the natural state of mating; it was formerly believed that they had to choose their own mates, and that arbitrary mating could not be arranged. However, the experience of Mr. Walter F. Van Dien over a period of years of experimentation indicates that forced matings can readily be made.



Characteristic pose of cock bird during courting period in early spring. Courtesy of Walt Van Dien and Michigan Department of Conservation.

While occasionally such attempts are foredoomed to failure their incidence is so infrequent that the practice may be recommended. Under this system the hens are separated from the males and placed in a separate corral quite some distance away. Here they remain from seven to ten days and then are carefully selected on the basis of type, plumage, style, record of performance, and size, and placed individually into breeding pens. Here they remain another week or so, and on a warm and sunny day, males are also carefully selected and introduced to them.

In the case of Hungarian partridge, it is the female that does the courting. Either member of a potential pair may chase a bird of either sex away from the small area where the courting is taking place. A pen with an opening

adjoining the mating yard must be available, for as soon as two birds have come to a mutual decision of acceptance, the cock starts to run and the hen, if in earnest, follows close behind.

After they have "run" into a pen, an attendant on duty closes the doorway. After this has been repeated for a total number of ten pairs, they are gathered up, each pair in a separate container and transported to their respective breeding pens. In the case of choice mating, 100 pairs of birds are introduced into one field for the choice-mating method, and each field should be 400 × 100 feet. Ten or fifteen pheasant or ground-type breeding pens can be used for the two ends into which the potential pairs run after making their choices. It takes about six days for one attendant to successfully watch, remove and care for the 100 pairs handled in this manner. Minor difficulties are apt to occur, such as the last five or six pairs refusing to mate with each other, and then too, about 3% of the pairs removed undergo a change of mind and have to be reintroduced into the mating yard for another attempt at finding a spouse. Time, labor and number of birds handled seems to be in favor of the forced-mating method.

Whichever method of breeding is handled, it should be gotten under way as early in March as it is relatively certain that warm weather will continue. Warm, sunny days are best for both methods and for this reason, it may be deemed necessary to delay the program until the end of March or the first week in April.

Grouping the Breeders, and Hatchability of their Eggs

The results of experiments have shown that older hens produce eggs with fewer discards among them, and these eggs had a slightly better hatchability. The chicks also had a slightly better viability.

The number of eggs laid per hen varies from season to season. As many as 88 eggs have been produced in a season but 75 eggs per hen would be a good average.

For pedigree work, individual pen cards bearing the hen's leg band number and her pen number for the season are used. On these, the egg records are kept including the quality of the eggs as well as the dates they are laid. These data are used in part to determine those hens that are to be reserved for the coming breeding season. For instance, the flock average, determined by dividing the total number of eggs produced by the total number nf breeding pairs for that season, indicates the flock average for any given year. Any hen which produced fewer eggs than the flnck average is not held for use as a breeder next year.

The hen's vigor, disposition and general type are other factnrs to be considered. In the case of the males, such factors as vigor, type, size and disposi-

tion, and his mate's egg fertility are deciding criteria, as to whether he is retained or shipped out.

The fertility factor is determined at the time that the eggs are candled, for then the infertiles and dead-germs are recorded after the pen number on the hatching record chart kept in the incubator house.

The first eggs are usually laid by the 15th to 20th of April and they are produced as late as the first of August. The majority of the females begin laying around the fifth to the tenth of May and egg laying begins to taper off about the last week in June. The peak of the laying flock's production is around the last week of May or the first week in June.

Releasing the Birds

Both adult and young Hungarians are either shipped or transported in trucks to the places of release. About fifteen adults and up to twenty-five young birds not over 16 weeks of age are crated together. Regions where small grains are abundant and also cornfields are satisfactory places for release.

The hatching and rearing of Hungarian bantam hens is the same as the procedure described for pheasants and the other game birds.

16

The McCarty Pens for Raising Pheasants, Bobwhites, Chukars and Hungarians

THE PENS ILLUSTRATED AND DESCRIBED IN THIS CHAPTER WERE ORIGINATED by Mr. George S. McCarty of New Jersey and are reproduced here with the kind permission of the Western Cartridge Company of East Alton, Illinois, and the Wildlife Management Institute of Washington, D.C.

These pens may be adapted for any of the upland game birds except turkeys. They combine with slight variations, a brooding pen, a rearing pen, and a breeding pen. They are simple to construct and inexpensive.

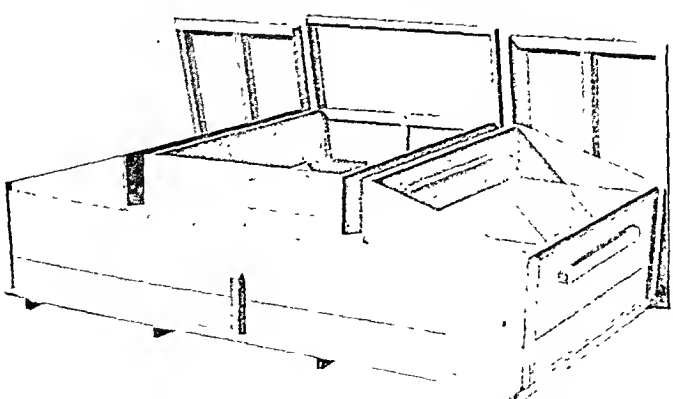


FIG. 1—Holding pen. All photos in this chapter courtesy of the Western Cartridge Co. and the Wildlife Management Institute of Washington, D. C.

The basic unit of equipment is the McCarty pen. It is 4 feet by 8 feet by 28 inches high and has a hardware cloth (wire) floor 6 inches above the ground. Figure 1 shows the pen as it is used as a holding pen for game.

How to Construct the Pen

To construct the pen, first obtain the following material from your local lumber dealer.

3 pieces 1 × 6 — 8 ft.
3 pieces 1 × 4 — 8 ft.
3 pieces 1 × 12 — 8 ft.
1 piece 1 × 1 — 6 ft.
1 piece 1 × 10 — 6 ft.
2 pieces 1 × 10 — 8 ft.
11 pieces 1 × 2 — 8 ft.
1 piece 1 × 1 — 8 ft.
2 pieces pressed wood 4 ft. × 6 ft.
1 piece "Celoglass" 16 in. × 5¼ in.
1 piece galvanized fly screening 38 in. wide × 78 in. long.
1 piece of ½ in. mesh galvanized hardware cloth 4 ft. wide × 8 ft. 2 in. long.
2 pieces of 20 gauge galvanized sheet metal 4 ft. long and 5 in. wide, formed in an acute angle 2½ in. from each edge so as to fit over the edge of the coop cover and hold it in place. This item should be obtained from a sheet metal or tin shop.
1 quart of green outside paint or shingle stain.
1 quart of white outside paint.
1 small box of ¾ in. wood screws.
4 hooks and eyes (2½ in. size).
¼ pound each of:
8 penny box nails.
6 penny box nails.
8 penny finishing nails.
Lath nails.

Preferably use such soft, easily worked, well preserved woods as white pine, yellow pine or cypress. Number 2 grade lumber is satisfactory. Any knot holes or large cracks that might admit flies or other insects must be puttied or covered with screen or otherwise closed.

Construct the pen in five separate steps building first the base, second the run, third the coops, fourth the coop covers, and fifth the run elevation cover. To do this cut the material you have received from your lumber dealer into the following pieces:

Coops:

2 pieces 1 × 10 — 4 ft. Saw out a wiodow 2 ft. 4 in. × 4 in. io the ceoter of one board. Plane a 45° bevel on one edge of each board.
2 pieces 1 × 2 — 4 ft. Plane a 45° bevel on one edge of each board.
4 pieces 24½ in. long × 9¼ in. wide at one end and 1¾ in. at the other end. Each board rounded on its diagonal edge.
1 piece of galvaoized fly screeniog, 32 in. × 5¼ in., to cover wiodow.
1 piece of "Celoglass," 16 io. × 5¼ in., to cover half of wiodow.

Coop Covers:

6 pieces 1 × 2 — 3 ft. 8½ io. Plane a bevel on one edge of each of two pieces.
4 pieces 1 × 2 — 27½ in. One end of each sawed oo a 45° aogle.
4 pieces 1 × 2 — 5 in. One haodle for each end of covers.
2 pieces of pressed wood, 27¾ in. × 4 ft.
2 pieces of 20 gauge galvaoized sheet metal 4 ft. long and 5 io. wide, formed io an acute angle 2½ in. from each edge so as to fit over the front edge of the coop cover and hold the cover in place.

Run Elevation and Cover:

2 pieces 1 × 4 — 4 ft.
2 pieces 1 × 10 — 4 ft.
2 pieces 1 × 2 — 35 in.
2 pieces 1 × 2 — 7⅞ in.
2 pieces fly screening 36½ in. × 11 in.
} Elevation.

2 pieces 1 × 2 — 4 ft. 1⅝ in.
2 pieces 1 × 2 — 36¾ in.
Pieces 1 × 1 — as needed.
1 piece of galvaoized fly screeoiog 49½ in. × 38 in.
} For run cover.

NOTE: Io constructing this pen take particular paios to have it close fitting in all parts so it will be fly proof, as flies are dangerous carriers of disease.

Base. Study Figure 2. Nail the ends of the pieces 1 × 6 — 8 ft. across the ends of the pieces 1 × 6 — 3 ft. 10½ in. Use 8-penny box nails. Nail the pieces 1 × 4 — 3 ft. 10½ in. across the frame made of the 6-in. pieces. Nail one in the center of the frame, one 23 in. from one end (inside measurement) of the frame, and the other 23 in. from the opposite end of the frame. Nail the pieces 1 × 4 — 23 in. in the positions illustrated. Nail all five so the sharpened edges are up. Place the piece of hardware cloth over, and staple it to the frame using ½ in. screening staples. Staple it first along one long edge of the base, then the other long edge, then across the ends. Do not let the hardware cloth

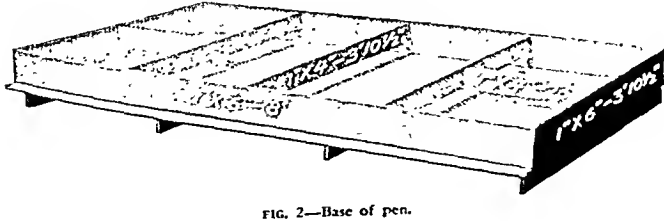


FIG. 2—Base of pen.

sag as you staple it, keep it tightly drawn. The ends of the wire will stick out a little. Cut them off, or bend them down with a hammer.

Run. Study Figure 3. Nail the ends of the pieces 1 × 12 — 8 ft. across the ends of the two pieces 1 × 12 — 3 ft. 10½ in. Use 8-penny box nails. Attach a handle to each end as shown in the picture; use the 28 in. pieces

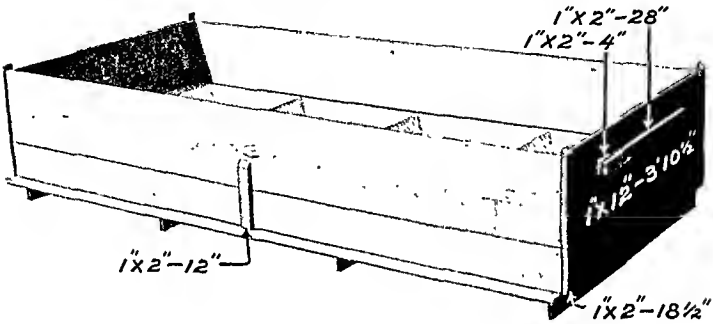


FIG. 3—Construction of run and manner of placing on base.

with one of the 4 in. blocks under each end. Now set the run frame onto the base and fasten the two frames very securely together by means of a 1 × 2 — 18½ in. cleat at each corner and a 1 × 2 — 12 in. cleat at the middle of each long side.

Coops. Study Figure 4. Cut a window 2 ft. 4 in. long × 4 in. high in the center of one of the pieces 1 × 10 — 4 ft. Nail the ends of this piece across the 9¼ in. ends of two of the diagonal pieces. Use 8-penny box nails. Be

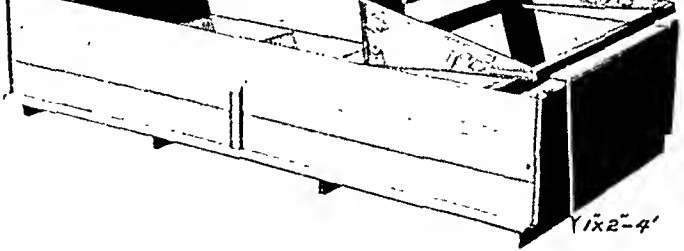


FIG. 4—Coop of pen and manner of placing in position.

sure that the bottom corners of all three pieces are flush and that the bevel on the piece 1 × 10 — 4 ft. slopes to the rear. Nail the ends of one of the pieces 1 × 2 — 4 ft. across the 1¾ in. ends of the two diagonal pieces, having the bevel edge of this piece sloping to the rear. Use an 8-penny box nail. Make a second coop the same, except do not cut a window in the piece

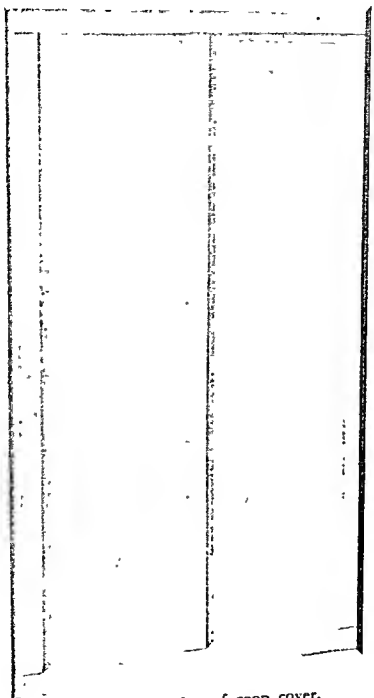


FIG. 5—Construction of coop cover.

1 × 10 — 4 ft. Place the coops as shown. If the top corners of the sides-frame are not flush, plane them down so that they are. Drive above five 8-penny finishing nails through the width of the piece 1 × 2 — 4 ft. at the back end of each coop, fastening it to the end of the sides-frame. Tack the piece of galvanized fly screening 32 in. × 5¼ in. over the window, and the piece of "Celoglass" 16 in. × 5¼ in. over the left half of the window, as you face it. Use screen tacks. Attach a hook to the side of each coop so that it will

hook in an eye attached to the end edge of each coop cover. This is to prevent the cover blowing off during strong winds.

Coop Covers. Study Figure 5. Place the edge of one piece 1 × 2 — 27½ in. across the ends of three of the pieces 1 × 2 — 3 ft. 8½ in. One of these pieces should have a beveled edge, with this edge on the outside of the frame. Nail the 27½ in. piece to the end of each piece it crosses, using 8-penny finishing nails. Fasten another piece 1 × 2 — 27½ in. to the opposite ends of the pieces 3 ft. 8½ in. Now lay the frame on a smooth floor or bench so that the bevel on the 3 ft. 8½ in. piece will be facing down. Get the frame perfectly square, then fasten a piece of the pressed wood over it, using ¾ in. screws. Fasten one of the sheet metal strips to the beveled edge of the cover; use ¾ in. screws. With 1½ in. screws fasten one of the pieces 1 × 2 — 5 in. to the end, top side, of each cover. Make a second cover in the same way.

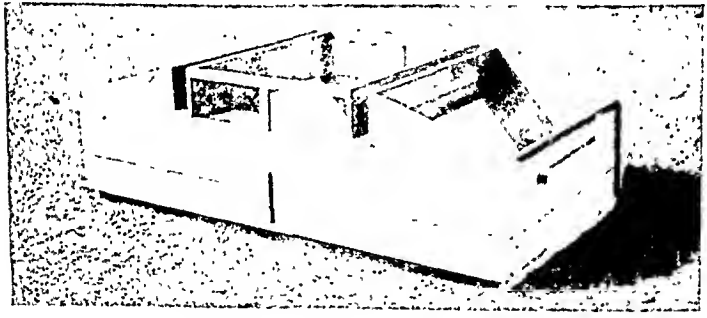


FIG. 6A—The McCarty pen. Run elevation.

Run, Elevation and Cover. Study Figure 6A. Place the two pieces 1 × 4 — 4 ft. flatwise across the top of the run, one piece against the front of each coop. Nail these to the top of the run, then nail the fronts of the coops to the 1 × 4 — 4 ft. pieces. Now put the two pieces 1 × 10 — 4 ft. in edgewise position across the run as shown. Nail these to the 1 × 4 pieces. Now fasten the pieces 1 × 2 — 35 in. in place as shown and attach the 1 × 2 — 8 in. upright supports. Cover the side openings with the pieces of 36½ in. × 11 in. fly screening.

To make the run cover first study Figure 6B. Nail the ends of the pieces 1 × 2 — 4 ft. 1⅝ in. across the ends of the two pieces 1 × 2 — 36¾ in. Fill in with the 1 × 1 pieces around the inside top edge of the frame just made, fastening them with long lath nails. Cover the frame with fly screening. The 1 × 1 pieces are necessary to seal the cracks against flies.

The pen is now completed except for painting. Paint it all green on the

inside. Paint the pen white on the outside as it will help to keep the interior of the pen cool.

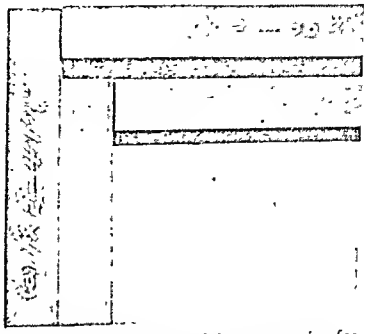


FIG. 6B—Detail of corner joint construction for run cover. (a) long side of frame.

How to Build a Platform

A platform for the McCarty pen to set on, while not imperative, is highly desirable for these reasons:

1. Disease-carrying flies and insects can be kept out of the pen.
2. It is easier to clean under the pen.
3. Rats and mice can be prevented from burrowing under the pens and frightening the birds.

Platforms may be made of wood or of concrete. Those of wood can be more economical and convenient. A very serviceable platform 4¾ ft. wide and 8 ft. long can be made of five 16 ft. pieces of 1 × 6 tongue and groove lumber, and 20 ft. of 1 × 4 lumber. Saw the 16 ft. pieces in half and fasten together as in Figures 7A and 7B.

Before placing a McCarty pen upon the platform, tack strips of rubber—these may be cut from old inner tubes—on the bottom edges of the base boards. This will eliminate all chance of cracks large enough to admit flies and other insects.

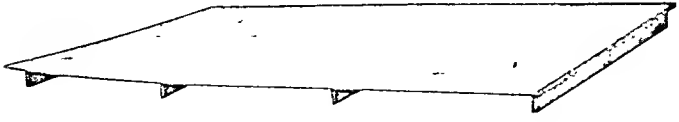


FIG. 7A—Top of platform.

FIG. 7B—Under side of platform showing detail of construction.

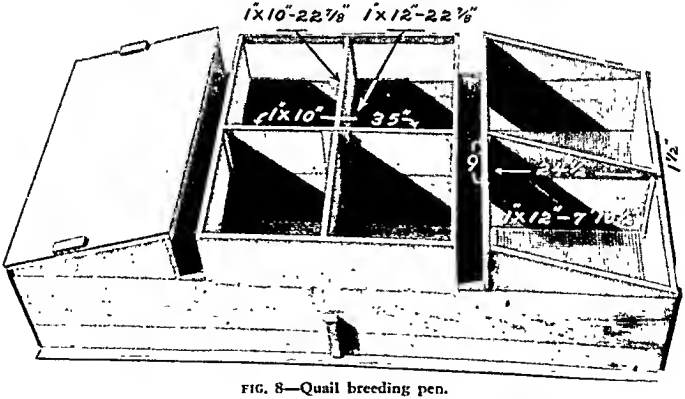
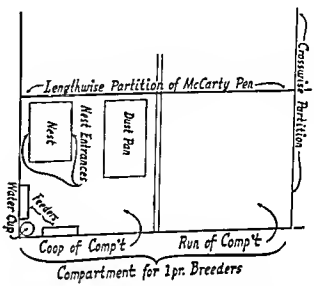


FIG. 8—Quail breeding pen.

Quail

Preparing Pen. Study Figure 8. Divide a McCarty pen into four compartments. To do this obtain a hoard 1 × 12 — 7 ft. 10½ in. Place this board edgewise in the pen dividing the pen exactly in the center lengthwise. To hold it in place nail a piece of plaster lath along each side of each end of the dividing board, nailing the laths to the ends of the pen run. Now, from a board 1 × 10 — 30 in. cut two diagonal pieces that are each 24½ in. long and that are 1½ in. wide at one end and 9 in. wide at the other. In the coop at each end of the pen place one of these diagonally cut pieces on top of the full length partition. Fasten each in place with two plaster lath cleats. Next cut a piece of 1 × 10 — 35 in. and place it edge to edge on top of that part of the full length partition that is in the open part of the pen. Attach lath cleats to hold it in place. The crosswise partitions require two boards 1 × 12 — 22⅞ in. and two boards 1 × 10 — 22⅞ in. Place these as shown and fasten with plaster lath. Paint these partitions as the rest of the interior is painted. The pen will now accommodate 4 pairs of quail, a pair in each compartment.



The following accessory equipment should be arranged in each compartment.

1 water cup
1 dust pan
1 wall feeder (for grit)
1 wall feeder (for dry feed)
1 nest box

17

Wild Turkeys

THE WILD TURKEY IS A MORE RANGY BIRD THAN THE DOMESTICATED turkey, having a longer neck, longer legs and a smaller head. It weighs less than the domestic turkey. However, wild turkeys raised under domesticated conditions profit by man's attention and weigh more than in their natural state, but still not as much as the domestic breeds.

The wild turkey is adapted to all sorts of country, open, forest and even swamplands. Its food sources are berries, acorns, seeds, grass and insects. Grasshoppers and crickets are the important insect foods. Nests are built on the ground and the young raised in dense cover. Turkeys roost in high trees, frequently changing their roosting places.

The following desctiption by Audubon not only confirms the thesis of the first chapter of this book as to the abundance of wild game that was once our heritage, but also tells us much about the habits of the turkey in its natural habitat.

"The turkey is irregularly migratory, as well as irregularly gregarious. With reference to the first of these circumstances, I have to state, that whenever the mast of one portion of the country happens greatly to exceed that of another, the turkeys are insensibly led toward that spot, by gradually meeting in their haunts with more fruit the nearer they advance towards the place where it is most plentiful. In this manner flock follows after flock, until one district is entirely deserted, while another is, as it were, overflowed by them. But as these migrations are irregular, and extend over a vast expanse of country, it is necessary that I should describe the manner in which they take place.

"About the beginning of October, when scarcely any of the seeds and fruits have yet fallen from the trees, these birds assemble in flocks, and gradu-

ally move towards the rich bottom lands of the Ohio and Mississippi. The males, or, as they are more commonly called, the *gobblers,* associate in parties of from ten to a hundred, and search for food apart from the females; while the latter are seen either advancing singly, each with its brood of young, then about two-thirds grown, or in connexion with other families, forming parties often amounting to seventy or eighty individuals, all intent on shunning the old cocks, which, even when the young birds have attained this size, will fight with, and often destroy them by repeated blows on the head. Old and young, however, all move in the same course, and on foot, unless their

Wild turkey hen approaching her nest.

progress be interrupted by a river, or the hunter's dog force them to take wing. When they come upon a river, they betake themselves to the highest eminences, and there often remain a whole day, or sometimes two, as if for the purpose of consultation. During this time the males are heard *gobbling,* calling, and making much ado, and are seen strutting about, as if to raise their courage to a pitch befitting the emergency. Even the females and young assume something of the same pompous demeanour, spread out their tails, and run around each other, *purring* loudly, and performing extravagant leaps. At length, when the weather appears settled, and all round is quiet, the whole party mount to the tops of the highest trees, whence, at a signal, consisting of a single *cluck,* given by a leader, the flock takes flight for the

opposite shore. The old and fat birds easily get over, even should the river be a mile in breadth; but the younger and less robust frequently fall into the water,—not to be drowned, however, as might be imagined. They bring their wings close to their body, spread out their tail as a support, stretch forward their neck, and striking out their legs with great vigour, proceed rapidly toward the shore; on approaching which, should they find it too steep for landing, they cease their exertions for a few moments, float down the stream until they come to an accessible part, and by a violent effort generally extricate themselves from the water. It is remarkable that immediately after thus crossing a large stream, they ramble about for some time, as if bewildered. In this state, they fall an easy prey to the hunter.

"When the turkeys arrive in parts where the mast is abundant, they separate into smaller flocks, composed of birds of all ages and both sexes, promiscuously mingled, and devour all before them. This happens about the middle of November. So gentle do they sometimes become after these long journeys, that they have been seen to approach the farm-houses, associate with the domestic fowls, and enter the stables and corn-cribs in quest of food. In this way, roaming about the forests, and feeding chiefly on mast, they pass the autumn and part of the winter.

"As early as the middle of February, they begin to experience the impulse of propagation. The females separate, and fly from the males. The latter strenuously pursue, and begin to gobble or to utter the notes of exultation. The sexes roost apart, but at no great distance from each other. When a female utters a call-note, all the gobblers within hearing return the sound, rolling note after note with as much rapidity as if they intended to emit the last and the first together, not with spread tail, as when fluttering round the females on the ground, or practising on the branches of the trees on which they have roosted for the night, but much in the manner of the domestic turkey, when an unusual or unexpected noise elicits its singular hubbub. If the call of the female comes from the ground, all the males immediately fly towards the spot, and the moment they reach it, whether the hen be in sight or not, spread out and erect their tail, draw the head back on the shoulders, depress their wings with a quivering motion, and strut pompously about, emitting at the same time a succession of puffs from the lungs, and stopping now and then to listen and look. But whether they spy the female or not, they continue to puff and strut, moving with as much celerity as their ideas of ceremony seem to admit. While thus occupied, the males often encounter each other, in which case desperate battles take place, ending in bloodshed, and often in the loss of many lives, the weaker falling under the repeated blows inflicted upon their head by the stronger.

"I have often been much diverted, while watching two males in fierce conflict, by seeing them move alternately backwards and forwards, as either had

obtained a better hold, their wings drooping, their tails partly raised, their body-feathers ruffled, and their heads covered with blood. If, as they thus struggle, and gasp for breath, one of them should lose his hold, his chance is over, for the other, still holding fast, hits him violently with spurs and wings, and in a few minutes brings him to the ground. The moment he is dead, the conqueror treads him under foot, but what is strange, not with hatred, but with all the motions which he employs in caressing the female . . .

"About the middle of April, when the season is dry, the hens began to look out for a place in which to deposit their eggs. This place requires to be as much as possible concealed from the eye of the crow, as that bird often watches the turkey when going to her nest, and waiting in the neighbourhood until she has left it, removes and eats the eggs. The nest, which consists of a few withered leaves, is placed on the ground, in a hollow scooped out, by the side of a log, or in the fallen top of a dry leafy tree, under a thicket of sumach or briars, or a few feet within the edge of a canebrake, but always in a dry place. The eggs, which are of a dull cream colour, sprinkled with red dots, sometimes amount to twenty, although the more usual number is from ten to fifteen. When depositing her eggs, the female always approaches the nest with extreme caution, scarcely ever taking the same course twice; and when about to leave them, covers them carefully with leaves, so that it is very difficult for a person who may have seen the bird to discover the nest. Indeed, few turkeys' nests are found unless the female has been suddenly started from them, or a cunning lynx, fox or crow has sucked the eggs and left their shells scattered about.

"When an enemy passes within sight of a female, while laying or sitting, she never moves, unless she knows that she has been discovered, but crouches lower until he has passed. I have frequently approached within five or six paces of a nest, of which I was previously aware, on assuming an air of carelessness, and whistling or talking to myself, the female remaining undisturbed; whereas if I went cautiously towards it, she would never suffer me to approach within twenty paces, but would run off, with her tail spread on one side, to a distance of twenty or thirty yards, when assuming a stately gait she would walk about deliberately, uttering every now and then a cluck. They seldom abandon their nest, when it has been discovered by men; but, I believe, never go near it again when a snake or other animal has sucked any of the eggs. If the eggs have been destroyed or carried off, the female soon yelps again for a male; but, in general, she rears only a single brood each season. Several hens sometimes associate together, I believe for their mutual safety, deposit their eggs in the same nest, and rear their broods together. I once found three sitting on forty-two eggs. In such cases, the common nest is always watched by one of the females, so that no crow, raven, or perhaps even pole-cat, dares approach it.

"A mother will not leave her eggs, when near hatching, under any circumstances, while life remains. She will even allow an enclosure to be made around her, and thus suffer imprisonment rather than abandon them. I once witnessed the hatching of a brood of turkeys, which I watched for the purpose of securing them together with the parent. I concealed myself on the ground within a very few feet, saw her raise herself half the length of her legs, look anxiously upon the eggs, cluck with a sound peculiar to the mother on such occasions, carefully remove each half-empty shell, and with her bill caress and dry the young birds, that already stood tottering and attempting to make their way out of the nest. Yes, I have seen this, and have left mother and young to better care than mine could have proved,—to the care of their Creator and mine. I have seen them all emerge from the shell, and, in a few moments after, tumble, roll and push each other forward, with astonishing and inscrutable instinct."

The physiological variations in wild turkeys and their significance in management has been made the subject of research by Richard Gerstell and William H. Long and is published in *Research Bulletin No. 2* by the Pennsylvania Game Commission. According to them, the common barnyard turkey is a descendant of Merriam's turkey of southwestern North America. Some of these which were domesticated by the Indians and taken to Europe were later brought back to the Atlantic seaboard colonies of America by early settlers.

Many of these domesticated turkeys wandered off the range and mated with wild turkeys. In addition, many wild turkeys reversed the process and came into the barnyard flocks and mated with the domestic strains. From this one may reasonably suppose that there is no absolutely pure strain of wild turkeys.

Since 1929 over 11,000 individuals have been raised and released on a 1200 acre Wild Turkey Farm. The original stock consisted of 100 crossbred "semi-domesticated" turkeys, hatched from eggs taken in the wild. The individual specimens all exhibited the chestnut-colored tail-band and other characteristics of the native eastern wild turkey. Their bodies were light and fusiform, their carriage erect. Except for the fact that they acted only "half wild," they outwardly appeared to possess all the attributes of "genuine" wild turkeys.

In spite of special handling methods, including a carefully planned "hardening off" process, many of the birds planted evidenced that most desirable characteristic of "wildness" to only a limited degree. In some few cases, groups of birds were released at carefully selected sites far removed from human habitations, where wild individuals were known to range. Instead of remaining in those sections, they shortly made their way to nearby farms, where they were wont to remain in spite of numerous attempts to drive them

back to the woods. However, there were some cases where the birds promptly reverted to the wild type and the plantings proved successful.

In order to increase the degree of "wildness" the following method was tried. Unmated "semi-domesticated" game farm females were confined in open pens located in remote sections of wild turkey ranges. The wild toms in the vicinity flew into the enclosures and mated with the captive hens. Then as fast as laid the eggs were collected and hatched. The poults hatched from them were propagated in the same general manner as the regular game farm stock.

The birds produced from the wild mating areas were far superior to the straight game farm individuals in displaying the factor of "wildness." This was manifested in several ways. Shortly after hatching from the egg, when one placed a hand in an incubator tray containing ten-to-twelve-hour-old poults from the wild-mating areas, and then shortly thereafter placed it in another section filled with game farm birds of the same age, hatched under identical conditions, a great difference in the reactions of the two groups was noted. The mating area birds showed a tendency to pull away from the hand as if afraid of it, while the game farm individuals appeared completely unaware of its presence. When the poults were removed from the incuhator and placed in carrying boxes ready for transportation to the brooder house, similar reactive differences were noted. The mating area peeps tended to duck and shy away from rapid movement made hy the human handlers, while the game farm group evidenced little or no reaction to them. The same results were obtained when a slight sound was produced hy scratching on the exterior surface of the containers. When birds of each class were placed on a table and induced to walk, the movements of the area poults were found to be more rapid, more precise and far better coordinated than those of the farm group. The eyes of the area peeps appeared to be more alert than those of the farm poults.

While all of these differences were very slight, they were highly significant in showing that "wildness" is a hereditary characteristic. Messrs. Gerstell and Long concluded that in turkeys "wildness" is not only the result of parental education, association with other individuals, and reaction to environmental stimuli, but also of hereditary factors. Definitely, cross-mated birds are superior to those produced by common game farm methods.

Bearing the results of the above research in mind, I shall discuss the methods of wild turkey production and its limitations.

The problem in raising wild turkeys domestically is the same as with all other game birds. Domestication tends to make them less able to fend for themselves upon release into the wild.

The ideal way to raise gamy turkeys is to simulate wild conditions A huge tract of land is enclosed with chicken wire about nine feet high. The

bottom three feet of this wire should be one inch mesh. It is trenched six inches below the ground level and then bent out at right angles extending horizontally six inches. The soil is then replaced. This is to keep out burrowing predators.

A breeding flock in the proportion of one male for every nine or ten females is placed in the enclosure. Pinioning of one wing is necessary to keep the breeders within the enclosure. A portion of the young stock raised in the area may fly out of the enclosure, but some are likely to remain. It is possible to trap the young stock and pinion them also.

Under this system the hens will hatch and rear their own young, and the poults will learn to fend for themselves under natural conditions. To assist nature and insure sufficient foods, various grains are planted. The kind will depend on the local crops raised. In addition, winter wheat and rye are planted to furnish green feed.

The disadvantages of this natural system of raising turkeys are obvious. To enclose a large acreage with nine feet of wire is enormously expensive. Planting of foods involves an expense almost equal to purchased feed, fed in the smaller yard. And finally so many more wild turkeys can be raised under the domesticated system that a surplus can be provided to allow for the losses entailed when the turkeys are on their own. Since it has been shown that turkeys in the wild are subject to the dread black head disease, Entero-Hepatitis, this expensive natural method is of no particular advantage in preventing disease. In fact, by proper control the domestic system of raising them on wire, or far away from grounds where domestic fowl are produced, may turn out to be an even better method of disease prevention.

A modification of the turkey-raising system described above is to raise birds on a two or three acre enclosure. The wiring is placed in the ground as explained in the natural system and extended upward about eight or nine feet. Traps are set at intervals to catch burrowing predators and the tops of posts are used for traps to catch owls and hawks. (Note—some states prohibit the use of such traps.)

The primary feathers of one wing are pulled when they are placed in the enclosure. Feed is supplied in large hoppers and a natural water supply is desirable. If such is not available large drinking fountains placed on platforms to prevent pollution are provided. This makes the entrance of an attendant less frequent and simulates more or less the natural system. Under this system the hens hatch their own eggs and rear their own young.

By the time the birds are ready for release the pulled primary feathers grow out again. The gate through which the attendant enters may be left open at the time for release. For the first few days the turkeys will cautiously go out of the door and may even return for food, but after a few days they will go out on their own. Birds should be released in the early fall when there is still

enough vegetation for them to feed on. If it is desired to keep the turkeys in the vicinity, adequate feeding stations should be provided as well as a source for drinking water. However, this is no guarantee that the released stock will remain near at hand.

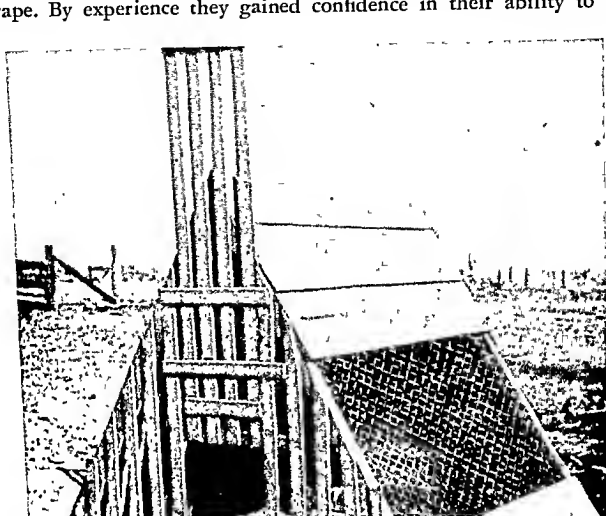
The kind of wire used in both of the above systems is a one inch hexagonal mesh, 18 gauge, three feet wide including the buried part. Above this is placed a four or five foot wide strip of two inch hexagonal mesh of the same gauge.

The third way of raising wild turkeys is to raise them the same way as the domesticated varieties. Since ordinary domesticated turkeys allowed access to free range often go wild, there is more than a fair chance of retaining some of the gaminess when wild turkeys are raised domestically. The writer had an experience which will bear this out. One season I raised a flock of White Holland turkeys in a region where foxes and other predators are abundant. At first these turkeys were raised on wire in a small coop and then transferred to the range. Each night the turkeys were driven into their house and locked in until morning. After going through this procedure for several months I thought they were sufficiently trained to enter the house of their own accord. I let them alone for several weeks and at no time did they enter the house at night, preferring the out-of-doors.

There is much room for experimentation in the raising of wild turkeys which would include two of the three methods. That is to say, raise the turkeys on wire in small enclosures, after incubating and brooding them artificially. Then transfer them to the two or three acre enclosure to give them a taste of life in the wild. After a year they could be released with some preparation for living on their own. The advantages of this combination system would be the production of larger numbers of young stock under artificial hatching and rearing, and the introduction of gaminess into the flock in the wide open spaces of the larger enclosure. Of course, this method would entail keeping the turkeys for a second year before release, but the matured bird would stand more chance of surviving in the wild.

Mr. C. O. Handley of the Virginia Cooperative Wild Life Research Unit reports an experiment in which some poults were raised in a portable quail unit and others in a conventional turkey house. The turkeys raised in the small units were wild when released in contrast to those raised in the larger house. Since the poults in both types of houses were fed exactly alike, the difference in degree of wildness was directly traceable to the type of enclosure of each set of poults. The explanation given was that the poults in the smaller enclosures in endeavoring to get away on the approach of the keeper, crowd against the opposite side of the pen and scramble over one another. The longer the keeper stayed about the more frantic the effort of the birds to escape. While noticeable even in the younger birds, the wild

instinct became more pronounced following the juvenile moult, and increasingly so as they grew older. On the other hand, poults reared in the conventional type turkey houses with large yards were able to get away as far as they liked on the approach of the keeper. With poults there was no pushing against the enclosure wire, or hurting one another in a frantic effort to escape. By experience they gained confidence in their ability to escape



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This is a well-built turkey brood coop which can be used either for setting a turkey hen or for raising a brood of poults.

should the necessity arise. The result was a domesticated wild turkey. In one instance, restraint against the will produced fear; in the other, freedom from restraint produced confidence. Recognition of these two factors is important in the artificial propagation of wild turkeys.

For commercial wild turkey producers the best method is the artificial incubation and brooding system. This requires less space, insures greater numbers of young stock, and is the most profitable. Natural incubation under a broody hen or turkey is unsatisfactory for several reasons. One must wait until the hen or turkey is broody. If placed under a hen, accustomed by na-

ture to hatch her young in 21 days, she is apt to tire and desert the nest before the additional week required for hatching turkey eggs has elapsed. If a turkey hen is used there is a loss of eggs she might be laying if not hatching out her young. The same applies to hen eggs, but since they are less valuable, the loss from the hen eggs not being produced during the hatching period is less. Since there are many custom hatcheries it is better to have them hatch the eggs in incubators if one wishes to use eggs from his own flock. A beginner would do well to buy turkey poults and save the investment required for incubators. The expense per poult is greater than if he hatched them himself, but there is no investment in plant or incubator. Furthermore, commercial hatching has become a highly specialized business and a great many turkeys and domestic hen producers now rely entirely on custom hatcheries.

Artificial Hatching

For those who wish to do their own hatching the following procedures are recommended.

Incubator manufacturers have accumulated a vast store of information about hatching and their direction should be implicitly followed. Both the forced-air type and the still-air type are used in hatching turkeys. For a description of these see the chapter on artificial incubation.

Forced air machines require a temperature of 99 degrees F. to 100 degrees F. for the first 22 to 24 days of incubation. For the last four to six days, 97 degrees F. to 98 degrees F. are sufficient. In the still air type of incubator, the temperature should run 100½ degrees the first week, 101½ degrees the second week, 102½ degrees the third week and 103 degrees the fourth week. The bulb of the thermometer should be level with the top of the eggs at all times.

Moisture is a definite requirement in the hatching of turkey eggs and should be supplied by sprinkling the eggs with warm water or adding it to the moisture pan. A hygrometer consisting of wet and dry bulbs is used to measure the relative humidity. The exact humidity requirements are furnished by the incubator manufacturer. A relative humidity of about 60 per cent for the first 24 days of incubation and about 70 per cent for the last four days is the general practice. Thermometers and hygrometers should be tested for accuracy before starting the hatch.

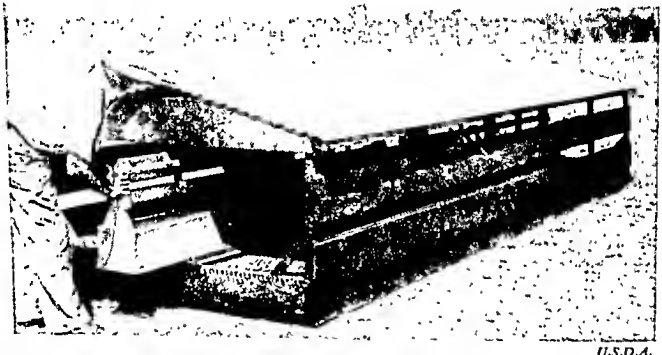
Turning

A brooding turkey in the state of nature pushing about in her nest eventually turns most of the eggs under her. Frequent turning of the eggs until the 18th day helps the developing embryo to adjust itself in the egg and prevents malformations. About five turnings a day at evenly distributed intervals

from early morning until night prevents the embryo from resting in the same position for two consecutive nights. The larger incubators sometimes have turning devices but in smaller ones a few eggs are removed from the center of the tray and the others rolled gently toward the center. The ones that have been removed are placed on the outer edges.

Taking off the Hatch

On the 33rd day of incubation the humidity should be raised and the turning of the eggs discontinued. The door of the incubator should not be opened more than once during the hatching period. When about half the chicks are



U.S.D.A.

A wasteproof, portable, outdoor shelter for feeder. The wire floor helps to prevent contamination from the soil and the roof provides shelter when the turkeys are eating.

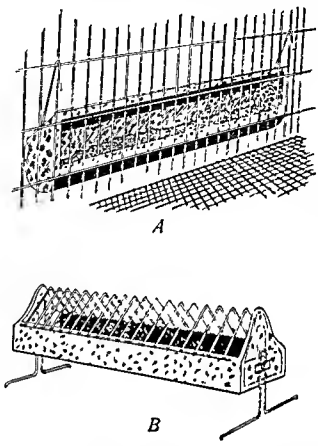
hatched they should be removed as the carbon dioxide they give off in breathing has a deleterious effect on the unhatched poults. In some of the larger incubators there is a special nursery tray into which the poults drop as they emerge from the egg. The incubators are usually darkened at hatching time to keep the poults quiet.

The newly hatched birds are placed into special poult boxes and quickly transferred to the brooder, where they are fed as soon as they are put in. Feed should be provided so that they don't eat the litter.

Artificial Brooding

The brooding of turkeys follows along the same lines as that of game birds and domestic fowls. The same rules for providing heat (as a substitute

for the body warmth of the mother), adequate space and sufficient ventilation apply here also. The same provisions for sanitation to prevent disease must be rigorously applied. Turkeys are highly susceptible to black head which may be carried by organisms in common poultry manure. They should never be brooded in batteries or houses which have been used to raise baby chicks unless these houses have been thoroughly disinfected. They should never be allowed to set foot on grounds on which poultry has been raised unless an interval of several years has passed. They should never be raised even in the immediate vicinity of the domestic hen because sparrows or other birds pecking at the poultry manure may carry the disease to the young poults. An attendant going from a poultry yard to a turkey yard may carry the disease on the bottom of his shoes.



A represents a sanitary type of metal feed-hopper designed for hanging on the outside of a wire-enclosed sun porch; B shows a type of metal feed-hopper with wire guard to exclude chickens and prevent soiling of feed with droppings. Courtesy of University of California.

Various systems and combinations of systems are used for brooding turkeys. Heat may be supplied by natural gas, oil, kerosene, coal or electricity. Poults may be brooded in long stationary brooder houses under hot water pipes, in portable colony houses with individual stoves or electrical heating elements heating the hovers, or they may be raised in batteries. Some breeders keep them on wire from the very first day until the turkeys are mature. Some combine the systems, brooding poults in batteries for three or four weeks, floor brood them for four weeks more, and then turn them out on the range. Others keep them in the batteries until they are six or eight weeks old and then either put them on wire or confine them on the floor of a turkey house. In all systems there must be protection from the elements, rats, burrowing predators, hawks and owls.

In any type of brooder house, or in any room where batteries are kept, a temperature of 70 degrees should be maintained. The most recent practices indicate that insulation of the floor, walls and ceiling is highly desirable from the point of view of heating costs, and that of less fluctuation of temperature due to external weather conditions.

The temperature under the hover at a distance of one inch above the floor should vary from 100 degrees F. at the very center to about 95 degrees at

the very edge. As the poults get older the temperature under the hover may be decreased, the optimum temperature may be ascertained by watching the young poults. If they are too cold they will cluster about the center; if too hot, they will gather around the outside edges. Frequent visits should be made to the brooding quarters, and the position of the poults carefully noted. Good poultrymen look in on the growing stock the last thing before going to bed and the first thing in the morning.

The floors of the brooder houses should be covered with litter or a wire hardware cloth frame of half inch mesh may be used. The wire hardware

U.S.D.A.

Interior of 16 × 25-ft. turkey house showing wire floor and wire under roosts.

should be two to four inches above the floor. This is a good method of providing ventilation because it permits a constant circulation of air and keeps the floor of the brooder clean, dry and sanitary.

When a large supply of slow-burning green wood is available, wood-burning brooder heaters provide the cheapest method of heating. There are on the market automatically regulated brooders, which if properly operated will burn wood so that the fire will last six to eight hours without refueling. *The Turkey World*, published monthly at Mount Morris, Illinois, is a good source for information about turkey equipment.

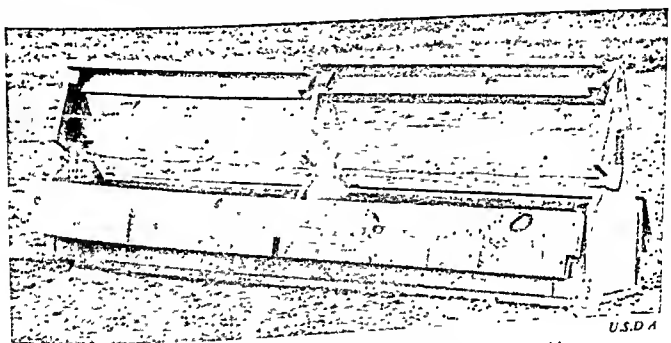
Litter

Sand and gravel may be used in place of litter for the first few weeks. After that shavings, grain straws, sawdust, crushed corn cobs and various other litters may be used. Whatever the material is it must be dry and clean

at all times. The more often it is changed the better. About twice a week is the common practice. There should be enough litter to cover the floors so that the poults don't scratch it away and expose the floors. The depth will vary slightly with the type of floor. A cold concrete or cold dirt floor will require more litter than a warm, well-insulated floor. After each brood is taken off, the floors should be cleaned and disinfected before a new brood is brought in.

Feed and Water Utensils

Feed and water utensils should be elevated slightly above the litter level to prevent fouling. Water devices should be thoroughly cleaned each day



Mash hopper for feeding young turkeys 12 weeks old or older.

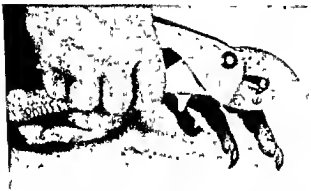
and fresh water supplied. Feeding hoppers should be cleared of droppings but need not be cleaned out so frequently. A number of small watering pans rather than one large one should be used, as the young poults haven't enough sense to look for water. The same is true of the feeders. Wire protectors to keep the poults from crawling into the feed or water should be used. Any farm supply store stocks a number of different kinds of feeding and watering devices. Metal feeders, though more expensive, are more commonly used than wooden ones, as they can be cleaned and disinfected more easily.

Feeding the Brooding Poult

Turkey poults require a starting ration containing more protein than do baby chicks. Feed is fed in the form of mash in feeders which provide about one inch of feeder space per poult. Various starter mash formulas have been worked out by commercial feed companies in different sections of the United

States based on the type of grain grown in a particular section. These average about 25 per cent crude protein. Due to the numerous components required it is hardly practical for a breeder to mix his own feed unless he is raising turkeys on a very large scale. Most feed companies have their own mixtures for "starters," growing feeds, finishing, laying and wintering feed for turkeys. Starting feeds are used for the first eight weeks during the brooding period. Then the growing feed is used. Wintering feeds are fed from the late fall, through the winter until about a month before laying time. Then laying feed is provided.

As soon as the poults are removed from the incubators they are placed under brooders and provided access to feed and water. By dipping their beaks in water and then mash they are taught to eat and drink. Special care must be exercised during the first few days to see that all the poults learn to eat and drink. A 25 c.c. pipette containing a very moist mixture of water or milk and mash may be used on backward poults. The small end of the pipette is put way down into the throat of the poult and feed blown in until the crop is nearly full. Water fountains are provided at the rate of one to every 50 poults.



Trimming the toenails of a male turkey to prevent injuries during the mating season. Courtesy of University of California.

During the brooding period dead birds should be removed at once and weakly poults isolated and fed with pipettes. The isolated birds should be kept warm after they are taken from under the hover. Coarse sand, insoluble grit should always be available to the brooding poults. Finely cut greens such as cabbage, grass, or lettuce should be scattered on top of the mash in quantities which can be cleaned up in a short while. These greens are fed twice a day, but should not be replenished unless the previous feeding has been cleaned up. During the first few days the poults should be stirred up frequently to keep them active. If necessary a few poults which are not too much older can be put in with the new arrivals to teach them how to eat and drink.

Rearing

The change from brooding to rearing should be gradual. During the seventh and eighth weeks the starting feed should be mixed with the growing feed on an equal basis to make the change to growing feed more gradual. At the end of the eighth week the poults are moved into a growing yard and allowed to run on the ground, or they may he put on a wired enclosure, where they are completely closed in on all sides including the top and bot-

tom. Scratch grain, such as cracked corn, or a mixture of wheat, cracked corn and barley may be fed in addition to the growing mash. Large water fountains should be provided with slatted tripods over them to keep the growing stock from polluting the water. Water should be changed daily and the fountains thoroughly cleaned. Foul drinking water is the most frequent cause of poultry diseases. Green feed is also essential during the growing period. If the young stock is pastured on a good sod no additional green food is necessary. However, when raised on wire, succulent green feed in the form of ground fresh cut hay, or any of the succulent green vegetables should be fed. A cabbage or lettuce head tied to a string and suspended at the head level of the stock is an excellent method of keeping the green feed from being polluted by droppings.

Feet of a male turkey after trimming the toenails. Courtesy of University of California.

Wing Clipping

When turkeys are kept in open yards it is necessary to prevent flight. This is accomplished by clipping the primary feather of one wing at various intervals. Heavy shears are used to cut the primaries to within an inch or two of the point at which they are attached. Wild turkeys should be clipped once at the age of eight weeks, again at about 15 weeks, and a third time at about 20 weeks. These periods can be varied by observation of the rate of growth of the cut wings.

Wintering the Breeders

In the late fall and winter the young stock should be fed a wintering ration and prepared for the laying period in the spring. The ration should be changed to one with less protein and more carbohydrate. Water fountains must be prevented from freezing. After the laying period the yearlings should be prepared for release as soon as there is sufficient vegetation to provide an ample food supply. Supplementary feeding stations should be set up until the turkeys become accustomed to their wild habitat. Where possible the turkeys should be kept over another year before being put entirely on their own. In such practice the primaries should be clipped again and the birds allowed range in a large enclosure simulating an almost wild habitat

Roosts

Unlike domestic hens, poults do not roost in dark places. After three or four weeks in the brooder house the young poults should be provided with roosts which are about one foot above the floor. These roosts can be so arranged that they are drawn up during the day allowing ample space on the floor of the brooder house.

Turkey hen with protective saddle. Courtesy of University of California.

During the growing period and the wintering period roosts should be built in the wire floor pens as well as in the open range. In a shelter they should be about two feet above the floor for the front roost and each succeeding one about six inches higher. The distance between the roosts should be two feet and the top or last roost about the same distance from the rear wall. About one linear foot is allowed per bird.

Out-of-doors roosts are built about seven feet above the ground with a sort of gangplank going up to make it easy for the young stock to perch. The gangplank is removed at night to prevent predators. In some cases where there is ample protection from predators, the roosts are built only a few feet above the ground.

STARTING RATIONS FOR TURKEYS

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C.

	*Parts**	*Per cent*
Wheat bran	1	7
Wheat middlings, standard or brown	3	21
Pulverized oats	2	14
Ground yellow corn	3	21
Alfalfa leaf meal (preferably dehydrated)	1	7
Meat scrap (50% protein)	1	7
Fish meal (60–70% protein)	2	14
Dried milk	1	7
Salt	.07	½
Cod-liver oil†	.21	1½
Total	14.28	100

Estimated crude protein, 24½%; crude fiber, 5.4%.

Remarks: The mash, along with chick-size scratch grain beginning at one or two weeks of age, and water to drink, is a complete diet administered with a minimum of labor. Finely cut fresh tender green feed may, if desired, be fed once or twice daily.

*When a formula is expressed in parts, any quantity of feed desired may easily be mixed by selecting an appropriate number (of pounds) as the unit or part. For example, if a grower wishes to mix about 175 pounds of this starter he would divide 175 by the total number of parts (14.28). The result, in round numbers, is 12, which is the size of the part. In the case of the salt and the oil the unit or part is multiplied by the decimals given. Thus the quantity of salt needed is .8 pound; and of the oil, 2.5 pounds. If on the other hand it is desired to utilize the ingredients in lots of a certain size as for example 100 pounds, this quantity is adopted as the unit. The result in this case would be 1,428 pounds of mash, all of the ingredients except the salt and oil being added to the mix from 100-lb. sacks.

U. S. DEPARTMENT OF AGRICULTURE,
Washington, D. C.

	Per cent
Ground yellow corn	15
Wheat bran	10
Wheat middlings (standard or brown)	12
Pulverized oats	20
Alfalfa leaf meal (dehydrated preferred)	9½
Soybean meal	10
Meat scrap (50% protein)	7
Fish meal (60–70% protein)	7
Dried milk	½
Salt	2
Cod-liver oil†	
Total	100

Estimated crude protein, 23.6 to 24.3%; crude fiber, 6.4%.

Remarks: Same as for No. 18.

†1% is satisfactory if high quality oil of fully guaranteed Vitamin A (500-A) and D (100-D) potency is used. In general, 2% or its equivalent ½% in fortified oil (2000-A, 400-D) is safer

THE UNIVERSITY OF CALIFORNIA,
College of Agriculture, Davis, Calif.

	Per cent
Soyheao meal (or cottooseed meal)	20
Ground milo, kafir, or corn	15
Wheat hrao or millrun	15
Ground wheat	10
Ground harley	8½
Dehydrated alfalfa meal (special grade)	10
Fish meal	12
Dried milk or dried whey	4
Steamed bonemeal	1
Ground limestone or grouod oystershell	2
Salt	1
Vitamin D carrier (400 D)	½
Caoe molasses	1
Total	100

Estimated crude protein, 24%.

Remarks: Tbe quality of tbe alfalfa is of the greatest importaoce because it is the main source of Vitamin A. It is suggested that 4 ouoces of manganese sulphate he premixed with each 40 lhs. of ground limestone.

UNIVERSITY OF KENTUCKY,
Lexiogtoo, Ky.

	Per cent
Ground yellow corn	20
Wheat hran	15
Wheat middlings	20
Finely grouod oats	10
Meat scrap (50% protein)	17*
Dried milk	10*
Alfalfa leaf meal	5
Fish-liver oil (85 or 100-D)	2
Salt	1
Total	100

Estimated crude protein, 22%; crude fiber, 5½%.

Remarks: Finely cut tender green alfalfa tops, rolled oats, or both may be scattered on top of the mash to start the poults eating. Beginning at the end of the first week place a mixture of equal parts wheat and chick-size cracked corn before the poults.

*If meat scrap and dried milk are available in only limited quantities, 1¼ lbs. of soybean meal may be used per pound of meat scrap or milk replaced; in which case 1 lb. of steamed bonemeal should be added for each 6 lbs. of soybean oil meal used.

GROWING RATIONS FOR TURKEYS

THE UNIVERSITY OF CALIFORNIA,
Davis, Calif.

(Semi-complete growing mash)

	Per cent
Meat scrap or soybean oil meal	15
Ground corn, milo or kafir	10
Ground wheat	10
Wheat bran or millrun	15
Ground barley	23
Alfalfa meal (high quality)	10
Cane molasses	1
Fish meal	8
Dried whey, dried milk or distillers' dried solubles*	3
Steamed bonemeal	2
Ground limestone or ground oystershell	2
Salt	1
Total	100

Remarks: Supplement with a scratch grain mixture. Start feeding a little at 8 weeks and gradually increase it until at 16 weeks the birds are eating equal amounts of scratch and mash. Do not increase the grain beyond this point to any class of bird except perbaps discarded breeders which are being prepared for market.

Access to green range, or 5 to 10 lbs. of fresh cut green feed per 100 birds per day is necessary.

Good quality fresh sweet rice bran may replace half the wheat bran.

*Carrying at least 30 micrograms of riboflavin per gram.

THE UNIVERSITY OF KENTUCKY,
Lexington, Ky.

(Simplified growing mash)

	Per cent
Wheat mixed feed	40
Ground yellow corn	20
Finely ground oats (or barley)	20
Meat and bone scrap (50% protein)	20
Total	100

Estimated crude proteio, 21%.

Remarks: To each 100 lbs. of the above mixture, add 1 lb. of fine sifted salt. Supplement with green range, water, and any common grain or mixture of grains. Soybean oil meal may be substituted for all but 3% of the meat scrap; 1¼ lb. of the meal to replace each pound of meat scrap, in which case 1 lb. of steamed bone meal should be added for each 6 lbs. of soybean meal used.

UNIVERSITY OF NEBRASKA,
Lincoln, Neb.

(Concentrate for growing mash; to be fed with grain)

	Per cent
Meat scrap	30
Soybean oil meal (expeller)	30
Corn gluten meal (yellow)	10
Alfalfa leaf meal	20
Ground limestone*	6½
Fine salt*	3½
Manganese sulphate (1 oz. to 250 lbs.)	*
Total	100

Remarks: Before feeding, this concentrate should be adjusted by mixing 300 lbs. concentrate with 700 lbs. of cereal products; preferably equal parts coarse ground corn, wheat shorts and ground barley or oats.

*Should be pre-mixed at the rate of 4 ounces manganese sulphate, 34¾ lbs. salt and 65 lbs. limestone; this 100 lbs. being sufficient for 1,000 lbs. of mash.

THE UNITED STATES DEPARTMENT
OF AGRICULTURE,
Washington, D. C.

(Simplified growing mash with soybean meal as the only protein supplement)

	Per cent
Ground corn	42
Wheat bran	10
Wheat middlings	15
Soybean meal	26
Steamed bonemeal	4
Ground oyster shell	2
Salt	1
Total	100

18

Aquatic Game Birds

DUCKS, GEESE AND SWANS BELONG TO THE ANATIDAE FAMILY. MANY REPresentatives of this family have been raised in captivity. The common mallard duck and the Canada goose are the varieties most frequently raised. The method of their propagation will be presented in this book. More venturesome breeders may apply the same methods to other varieties, without varying too much from the procedures outlined herein.

As in the case of upland game birds state licenses are required in most states. In addition, Federal permits are required to buy or sell migratory waterfowl, including wild ducks, geese and swans reared in captivity. These may be obtained from the Fish and Wildlife Service, United States Department of the Interior, Washington, D. C. The state agencies are listed in Appendix I.

Ducks are usually classified as River Ducks and Sea Ducks. Of the former group, mallard, blackduck, Florida duck, gadwall, baldpate, green-winged teal, blue-winged teal, cinnamon teal, shoveller, pintail and wood duck are all edible. Of the Sea Ducks, the canvasback, redhead, ruddy duck, and scaup are desirable for table purposes. Other varieties of Sea Ducks such as the mergansers, ring-necked duck, golden-eye, bufflehead, old-squaw, harlequin duck, eider, velvet scoter and a number of other varieties often taste too fishy for human consumption.

The mallard duck is easy to raise. It is a good ranger and able to shift for itself to a great extent as do mallards in a wild state. However, its food supply must be supplemented by the breeder if he doesn't want the birds to wander or fly off. Where wire enclosures are used, which limit the ducks' freedom of search, most of the food must be supplied.

Although thousands of domestic ducks have been raised on land without

any access to water (save for drinking water), the most universal practice of waterfowl breeders has been to provide swimming facilities. If waterfowl are being raised for release as game birds, undoubtedly the provision of a natural habitat, which includes a body of water, is desirable. However, if game birds are raised with the idea of supplying the needs of immediate food consumption, the practice of raising them on land without access to water will provide a more tender bird for human consumption. For, by limiting the exercise of the swimming bird, the development of muscles is deterred, and the fowl is less tough. To retain the natural vigor of the birds a compromise system of breeding is possible. Breeders are allowed full access to water, while the young stock is raised entirely on land. The amount of extra feed necessary under the land system of raising game fowl is offset by the more rapid gain of flesh where the exercise of ducks and geese is limited.

The Pond

For a beginner, the more natural way of providing a small body of water is recommended. As a general rule about two-thirds of the area to be used should be land and about one-third water. There is no definite set rule as to the number of fowl which can be raised on a given area. Two hundred breeding mallards have been raised on a three acre enclosure. One acre of water would be ideal but mallards have been raised on even smaller bodies of water. Natural marshy growths adjacent to the water may make up for a lack of open water. Natural cover on the adjacent land, where fowl can supplement their food supply by devouring small insects, may also be a factor in permitting a smaller body of water to be used. A pond or a dammed-up brook with an inlet and outlet providing for a constant renewal of fresh water insects will help overcome the handicap of a smaller body of water.

A body of water of limited size is preferred to a larger body for several reasons. On a limited body it is easier to locate the nests of waterfowl. This is of considerable advantage when it is desired to incubate the eggs under hens, or artificially in an incubator. Further, in a small body of water it is easier to control the natural enemies of water birds such as snapping turtles, black water snakes, pickerel and black bass. A smaller lake or pond is less expensive to enclose with a wire fence.

Many varieties of ducks like to build nests on an island and where possible a small island should be provided. A very gradual slope from the land into the water is highly desirable. This should be provided at least on one side of the body of water. A protecting bank which shelters the birds from the north and west winds is ideal. If this cannot be provided, a shelter belt should be grown back on the land for this purpose. Where houses are erected for winter quarters, the exposure should be southern, so that the back wall constitutes a windbreak.

Planting

Where natural water vegetation is lacking certain plants such as wild rice and wild celery should be planted. Fertilizing lakes and ponds is an accepted practice where fish are raised, on the proven fact that the fertilizer encourages the growth of water plants. However, it is important to grow plants which are indigenous to a given region. The Game Food Nurseries, P.O. Box 371 A, of Oshkosh, Wisconsin, specialize in regional water plants and furnishes free information as to the best types of plants for particular localities. Terrell's of Oshkosh, Wisconsin, also provides the same service. Such plantings are for large lakes and swamp areas rather than enclosed yards.

Where possible, alternate swimming places should be provided so that while plants are being raised in one pond, the fowl can use the other. Water cress, water weed, coon tail and duck weeds are good plants for ponds.

For nesting sites it is advisable to provide plantings some distance away from the shore, which is too exposed. Where fences are used these can be covered with bittersweet, woodbine or Japanese honeysuckle. Any low shrubs may be planted away from the fences to provide nesting places. Small mounds of cornstalk can be erected until more permanent growths get established. An ideal situation is where the stream or pond adjoins a wood with sufficient ground cover. In addition, short grass on a more open range near the pond is highly advantageous, especially where geese are being raised. Geese are great rangers and crop the grass closely. This reduces the feed bill considerably. The droppings of geese are very fluid and spread over a large area more evenly than any other animal. It is highly advisable to alternate ranges for geese so that the unoccupied areas may be reseeded. Where harvests have been gathered it is well worth while to allow geese the run of the planted fields to gather up the unwanted parts of the plants. The resultant fertilization of crop areas will prove highly beneficial to succeeding crops.

Shelter

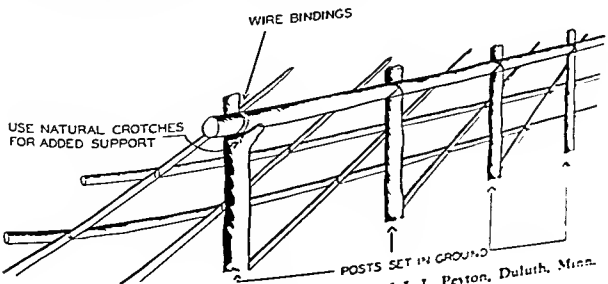
Waterfowl do not require shelter at any time of the year as is attested by the fact that the wild species fend for themselves. However, it must be remembered that they do migrate southward when cold weather approaches and even then may fall victim to severe cold spells. For domestic production a simple wooden structure with clean bedding is advisable. During severe weather the birds must be driven intn shelter as they dn not naturally go there. This purpose can be achieved hy feeding them clnser and clnser to the shelter as cold weather approaches. Finally all feeding should be dnne in the shelter. Running water freezes less easily than still water and waterfnwl usually try to keep a small swimming spot open as the water freezes.

Where they are driven into the shelter at night, and kept there, the breeder may break open a small section of ice for them to swim in. However, it is not entirely necessary for them to have access to water during a very cold snap. If plenty of bedding is provided and changed as often as it gets wet and foul, mortality may be considerably reduced by keeping the birds on land. The feet of waterfowl are their vulnerable parts since these are not covered by their oily feathers. This emphasizes the need for dry bedding. When birds are kept on land and confined to shelters provision must be made to close them in at night. When there is snow on the ground their tracks are a dead giveaway for foxes, probably the worst of their natural enemies.

Other vulnerable parts of waterfowl are their bills, which are sometimes likely to freeze in very cold weather. To compensate for the lack of range on land and in the water, heat-producing grains should be amply fed. Well-nourished birds are in a position to withstand the cold, and ward off diseases that attack debilitated stock. Where birds are benumbed by cold more personal attention is required. They should be brought into a heated cellar, fed and watered, and confined there until the weather becomes milder. Do not shorten the recuperation period. Err on the side of keeping them from exposure a longer time rather than a shorter time.

Where an attempt is being made to propagate subtropical varieties of geese, such as Egyptians, Cereopsis (Tasmanian goose from Australia), Barhead and Blackbacked goose (from India), which are less adapted to our northern climates, insulated shelters should be constructed. Young stock, reared in early spring, may require some artificial heat beyond the brooding period. However, heat is only necessary with the subtropical varieties, and then only when we have unusually severe cold spells.

Mr. & Mrs. J. L. Peyton, Route 2, Box 743, Duluth, Minnesota, who specialize in raising all kinds of geese, utilize a framework of poles, such as shown in the illustration for winter housing. They cover these with baled



Framework of winter shelter for geese. Courtesy of J. L. Peyton, Duluth, Minn.

hay or straw. A stout ridge pole is necessary as well as strong upright supporting poles, since the structure may have to support a heavy weight of snow. The uprights are set firmly in the ground before it freezes. The ridge pole and rafter poles are then set on and firmly attached with baling wire. The smaller cross poles are set upon these and then the hay is put on. To keep the hay from blowing away a few poles are put upon the hay. It is best to use weather-beaten hay from the outside of the stack as this is unpalatable to the geese and they won't eat it away. This refers particularly to the hay at the lower end of the rack where it is accessible to the geese or ducks. Where shelters are provided it is easier to locate the eggs.

A high, dry and sheltered location should be used for housing for ducks or geese. Allow about five square feet per goose and about four square feet per duck. When geese or ducks are on a range where there is no shelter under trees or bushes, small, light shelters should be provided. These should be portable so that they can be moved easily when the range is changed.

Fencing

Since it is assumed that both geese and ducks will have their flight feathers clipped on one wing to prevent flying, a fence about two and one-half feet is all that is required. Fences with open strands at the bottom are frequently used. Beyond an occasional supporting pole, especially at the corners, no other supports are needed. The open strands are forced into the ground by the pressure of a foot. These fences are easily put up and taken down when they are required for a new range. In the fall of the year when the house garden is harvested, the fence can be put around it and the ducks or geese allowed to range in the garden. They will quickly consume the leftovers, the stalks and the weeds.

If sufficient range is provided ducks and geese will stay around the home territory even though they may fly off at times. Occasionally they will go off to join their wild brethren. As the range thins out, change it.

Where goslings and ducklings are to be reared, a different system of fencing should be followed. Here we are not concerned primarily with keeping the ducklings or goslings in, but with keeping the predators out. The young ones are easy prey for foxes and other predatory animals. The construction of the fences to keep out predators has been described in Chapter 9.

Geese

Although Canada geese are more frequently raised domestically than other breeds of wild geese, the following are often bred: the Snow, Blue, Hutchins' and White-fronted geese. In addition geese from countries other

gradually the flock increases. Where there is a desire to hasten the forces of nature, eggs are removed from the nests to encourage the goose to lay more and the eggs hatched under broody hens or in artificial incubators.

For the beginner or the person desirous of starting in a small way, brooding under hens is most advisable. The equipment required is not expensive and since each hen will cover only four or five eggs the risk is distributed. For a nest box an ordinary orange crate with two partitions may be used. Remove all but one piece of the top of the box. The box is then turned so that this forms a base rail. A heavier piece of wood is then nailed to the top of the opening coming down about two inches. This piece is used to hinge doors on. The doors can be made of any piece of scrap wood and should overlap the front bottom board. A brick or a rock can be placed against it to keep the hen in.

A piece of grass turf about three inches thick with the grass side up is then placed in each nest and shaped into a shallow saucer shape. Some dry shavings, sawdust, or straw is scattered on top of the sod. To liberate the hen for feeding, open the door and throw it back on top of the box. The nesting boxes may be set in a barn, poultry house or even left outdoors in a sheltered spot.

The date when laid and the breeding number is written at each end of the egg. A few extra hens which are broody are kept on hand on artificial china eggs. Since it takes a week longer to hatch a goose egg than a hen's egg, some of the brooders may get impatient and restless. They should then be replaced by the spare hens. When the hens are removed for feeding at a regular time each day, the eggs should be turned by hand. If the weather is at all dry, warm water should be sprinkled on the eggs. Before setting a hen on the nest dust her carefully with sodium fluoride. About the tenth day examine the eggs for fertility by holding them up to a strong light. If the dark splotch of the spiderlike embryo cannot be clearly seen, the egg is infertile. Remove infertile eggs and double up. The date mark is useful here so that the remaining fertile eggs can be put into a nest with other eggs laid at the same time.

When not enough broody hens are available eggs may be started in a small incubator. Put plenty of water in the trays. After ten days the fertile eggs may be put under hens. The incubator may be used again after the hens hatch the goslings, to dry them off. In a day or so they can be put back under the hens. If in the course of breaking out of the egg a gosling gets a good portion of her bill outside of the egg and doesn't seem to make progress, push it gently back, cover the hole with a piece of shell and hold it in place with scotch tape. Then let the gosling try again.

There seems to be some difference of opinion among breeders as to whether or not it is worth while to help the young goslings out of their shells. In the

case of chickens it has been pretty generally accepted that chicks which are helped out of the shell don't have the required stamina to go on living. However, some breeders have found it worth while to help the goslings out of the shell. The lack of fairly warm water applied to the eggs may be a cause for goslings failing to break out. It cannot be emphasized too strongly that since geese are water birds there must be adequate compensation of moisture when the eggs are hatched under a land bird. Some people even moisten the breast of a brooding hen. During the last week of incubation the warm water is especially important for good hatching. Dr. E. L. Dakin of Ohio State University recommends dipping the eggs in lukewarm water at least twice a week. The eggs should remain in the water a little less than one minute.

Artificial Incubation

The percentage of hatchability of goose eggs is lower than that of hen's eggs. An experienced operator may get a hatch of from 70 to 75 per cent of the fertile eggs set in an incubator. These figures are the ones which the Peytons consider about right. There is still room for a great deal of experimentation in the artificial incubation of goose eggs. Some prefer the still-air type of incubator and others the forced-draft type. There is an important difference in the temperature requirements when you use one machine or the other. For the still-air type Dr. Romanoff of Cornell advises 101½ degrees throughout the hatch with a relative humidity of 70 per cent up to the 25th day and 60 per cent after the 25th day. For the agitated-air type incubator (with separate hatcher) Dr. Romanoff recommends 99½ degrees throughout the hatch with 70 per cent relative humidity up to the 25th day and 60 per cent after that. In the agitated type the eggs are put into the hatcher after the 25th day. In both types of incubators the eggs are turned 180 degrees, two to four times daily, up to the 25th day. They are not turned after that. Dr. Romanoff leans toward the still-air type of incubator for hatching goose eggs. According to him, because of the different rates of air movements in various makes of still-air incubators, the average reading temperature may vary from 100½ degrees to 102½ degrees F. or higher. These conditions are given at a room temperature of 65 degrees F. If the room temperature is below, for example 45 degrees F., the incubator temperature should read about one-quarter to one-half degree F. higher; and if the room temperature is high, for example 85 degrees F., the incubator temperature should read about one-quarter to one-half degree F. lower throughout.

The reading of the temperature is ordinarily made at the height of two inches from the egg tray level. When the bulb of the thermometer is higher than two inches, the temperature should be read higher, and when the ther-

mometer is lower than two inches from the bottom of the egg tray the temperature should read lower.

Excessively evaporated or old eggs should have higher humidity than unevaporated or fresh eggs.

There has been very little experimentation in the artificial incubation of wild duck eggs. While many thousands of mallard eggs are incubated artificially every year no exact experimental evidence has been published. Dr. Romanoff's work with White Pekin and Indian Runner ducks may be used as a guide in the incubation of wild duck eggs. In his experiments duck eggs required about one-quarter degree higher temperature than goose eggs. Different types of incubators would require slightly different temperatures, so it is difficult to give exact and fast rules. Some reliance must be placed on the incubator manufacturer's directions and some individual experimenting on the part of the breeder.

Rearing Aquatic Game Birds

Both ducklings and goslings may be raised by the natural method, using hens as the mothers. The practices described previously in this book for the natural rearing of pheasants apply also to the rearing of young waterfowl.

Artificial brooders such as used in the brooding of upland game birds are also used for waterfowl. The more rapid growth and the much larger size of waterfowl entail a different and more rigid method of feeding and sanitation. The pens must be cleaned more often as there is much more excrement. The feeding is in the form of a wet mash and the sloppy food splashed around by the ducklings or goslings befouls the litter. Feeding five times a day in quantities that will be cleaned up quickly is the approved method. After each feeding, or at least twice a day, the feeding utensils should be fairly well cleaned out so that the leftover food particles don't get sour. Drinking water should be protected by every possible means to prevent the young birds from getting their feet into it. Placing the feed hoppers and fountains on one-half inch hardware wire-covered platforms makes for more sanitary conditions.

A number of feeding formulas for ducklings and goslings may be used. A sample feeding program is as follows:

Do not feed until they are at least 36 hours old.

The first two days feed equal parts of rolled oats and bread crumbs. Provide sand for grit. All of these should be moistened.

After the third day wheat bran and cornmeal may be added to the mixture.

From the first week on, add wheat middlings and about five per cent by weight of meat scrap. The feeding may be reduced to four times daily after the first week and three times after the first month. Goslings and ducklings

should be given limited amounts of green succulent feed after the first week and allowed to range on grass after the first month.

Young waterfowls are far more hardy than upland game birds.

For geese, the Peytons recommend a brooding temperature of from 80 to 85 degrees under a hover for the first week and dispense with heat after ten days or two weeks. From 100 to 125 may be brooded together under one hover. Other goose raisers dispense with artificial heat altogether and put a number of goslings in a ventilated basket depending on the body warmth of the young birds to furnish adequate heat. Goslings are kept away from swimming water for the first month, but are allowed to range on grass pasture after the first week. However, during the first month they must he driven indoors when caught in the rain. Ordinary hroiler mashes, moistened, are fed to young goslings but the amount of grain is decreased as the hirds get older and live more off the range. As they approach the age of three months whole grain is substituted for mash. The Peytons recommend one-tenth of a pound of grain per head for geese from the time they are one month old, when the pasture is good and unlimited. Where they ate confined to a limited pasture, a quarter of a pound of grain or even more per head should supplement the pasture feeding. Grain should be scattered broadly so that all geese get a fair share of the feed.

Ducklings are not as good grazers as goslings and therefote should have larger grain rations in proportion to pasture. Since ducklings are considerably smaller than goslings the amounts used for geese mentioned above may he used for the ducklings to compensate for the decreased amount of food gathered from the range.

Since there are a far greater number of duck eggs available than goose eggs, and many more ducklings hatched, the ducklings are brooded in very large numhers and an occasional death is not as serious a matter as in the case of goslings.

The Peytons recommend the following

RATION FOR BREEDING GEESE

200 lbs. yellow cornmeal
200 lbs. pulverized oats
200 lbs. ground wbeat
100 lbs. ground barley
100 lbs. soybean meal
50 lbs. dehydrated alfalfa meal
50 lbs. meat and bone scrap
50 lbs. dried skim milk or dried buttermilk
20 lbs. of ground limestone or ground oystershell
10 lbs. of salt
1 gallon of fortified (400 9- 3000 A) cod liver oil, or more if oil is weaker
4 ounces of manganese sulphate

Ohio State University recommends a mixture of corn. wheat and oats during the winter season and during the breeding season. After the breeding season the geese are put on green pasture.

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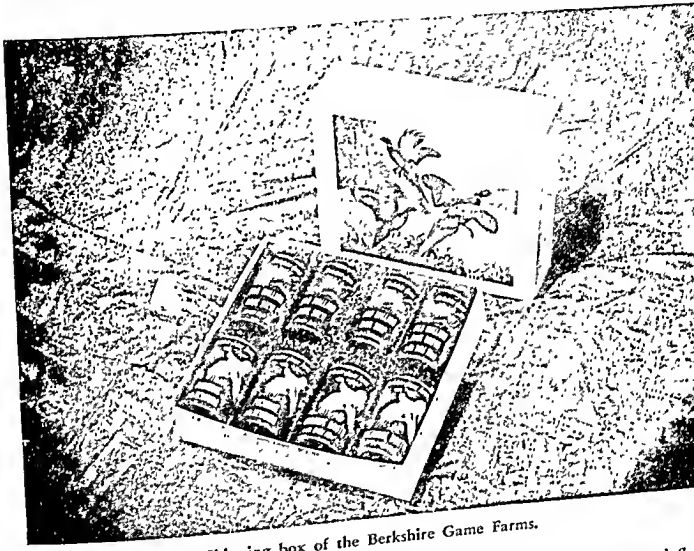
berries. Range yards properly sodded help game birds prepare for the time when they are on their own. The larger the area per bird in holding pens or range, the better.

Breeding practices are also a factor in raising game birds. In selecting birds for breeding purposes, disease-free individuals who show extreme flightiness should be chosen. A visit to a few game farms before embarking in the business of raising game birds is highly desirable. I have approached farms where the pheasants on range were almost as tame as domestic poultry,



Shipping box of the Berkshire Game Farms.

and others where my approach was greeted with a wild scampering and flying against the tops of the covered pens.

Some breeders combine the raising of game birds for release with production for the food markets. The culls and surplus birds are diverted to the consumer markets. Of late years several game farms have made a specialty of catering to gourmets, through extensive advertising campaigns. Since they cannot produce enough birds on their own farms to justify so large an advertising campaign, they purchase game from other breeders and market them along with their own.

In some instances there is a direct sale to the consumer, and in others the wholesale poulterers furnish the market. It should be stated here that special

19

The Marketing of Game Birds

BREEDERS OF GAME BIRDS SHOULD DETERMINE AT AN EARLY STAGE IN THE process what particular market they are aiming at. Obviously if pheasants, quail, mallards, or turkeys are to be raised for the food market, the more weight that can be put on them the better. Further, their ranging should be so restricted that they will exercise as little as possible in order to keep their muscles soft.

Where the market is gun clubs, or state game commissions, or private preserves, it is obvious that the wilder and more active the bird, the better. Pheasants, quail, and mallards have been so domesticated that they will eat out of your hand. Wild turkeys have often mixed with their barnyard brothers and become so domesticated that they don't offer real shooting for sportsmen.

According to Mr. Earl R. Holm of the New York State Conservation Commission, his office is interested in buying pheasants which live up to the following standards. They must be strong fliers, fully feathered, healthy and capable of surviving. Mr. Holm believes that weak fliers may be due to the practice of wing clipping, improper use of brails or extremely close confinement. The question of brailing is a moot one among game breeders. Some believe that it should be done away with and birds raised in covered pens. This involves considerable expense for the cost of covering. However, advocates of this system point out that it takes time and labor to catch up the birds and brail first one wing, and after a few weeks, the other wing. On the other hand, there are breeders who practice brailing and have successfully sold pheasants which satisfy those who buy them for release and shooting.

Mr. Holm also emphasizes the need for feeding hard grains in addition to mash, to give the gizzard muscles proper exercise so that when the bird is on his own in the wild, he is adapted to the eating of weed seeds, cereals, and

Where birds are killed by sticking, they are put into a funnel, head down so that it projects from the small end. Any narrow-bladed knife which will cut the jugular vein and pierce the brain is suitable. Bleeding should be permitted until a half hour has elapsed. A humane killing device is manufactured by the Kleen-Way Company of Woodstock, Illinois. It cuts the artery and pierces the brain in one operation.

Wax plucking is now being used by many game bird raisers. A commercial wax is purchased and applied as directed by the manufacturer. After the bird is properly bled, some of the feathers which come off easily are either picked dry or slack scalded. The large wing and tail feathers particularly should be removed. Primary covert feathers are plucked out with a pair of pliers. In the case of slack scalding, the temperature of the water used is anywhere between 155 degrees F. and 180 degrees F. The bird is dipped into the water for about 40 seconds and the majority of the large feathers plucked. When the remaining feathers are thoroughly dried out, the bird is dipped into wax and the rest of the feathers plucked. In large scale operations, a blower is used to dry the feathers before waxing. In the dry-picking operation, the rough picking is done as soon as the bird is killed. The bird is then hung in cool air until the body temperature is about 70 degrees F. and then put into the wax for final picking.

The semi-scald method of picking, practiced largely by the packing indus-

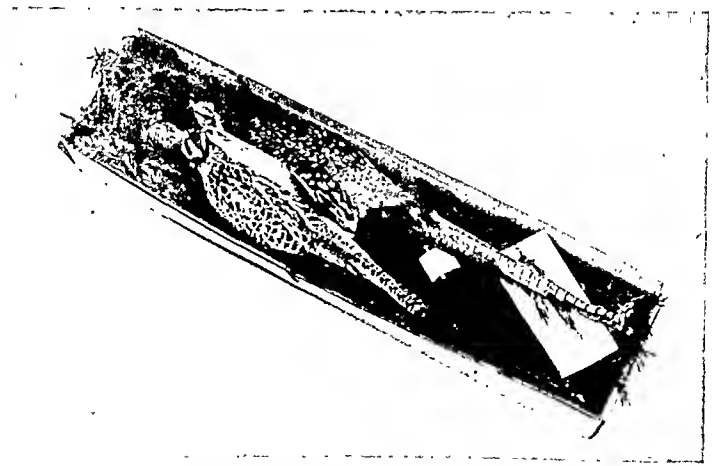
Shipping box of Fin'n'Feather Farm.

state licenses are necessary in most states in order to sell game for food and, further, many states forbid it altogether. Before considering this aspect of the business apply for information to your state conservation commission. See Appendix I.

Game birds are usually shipped to the market in full feather. Sometimes in accordance with local market requirements the birds are shipped with the head and neck feathers left on and the rest of the carcass picked.

The birds are killed by strangling, being stuck with a knife, or shot. State regulations must be followed as to the method employed. After being killed, game birds are hung in a cool place to allow the animal heat to dissipate. This takes about 48 hours. Where markets are near enough for shipment by motor truck they are sent to market immediately after the 48 hour cooling. For longer shipments the game is frozen hard after the 48 hour cooling and then shipped.

After the birds are killed, they are drawn, without removal of feathers. They are then hung by the neck and kept in the shade, after the insides are wiped out with a damp cloth. No blood clots must be left in the interior. This is particularly necessary when the birds have been shot. Blood clots will make the flesh sour. The birds should be kept hung in an openwork gunny sack, which will protect them from flies. If they are wrapped tightly and no air is admitted, they are likely to spoil.



A brace of pheasants from the Berkshire Game Farms.

The above quotations may vary from year to year, but the figures given above show the comparative prices of the different kinds of game, and future prices will probably be quoted proportionately.

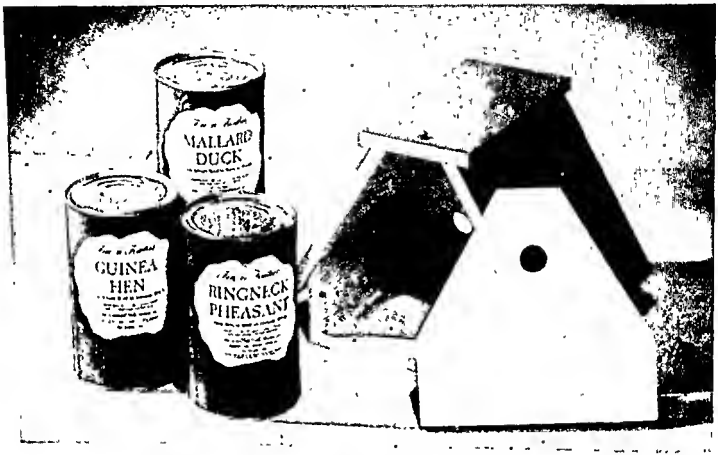
Berkshire Game Farms, whose city address is 271 Madison Avenue, New York 10, N.Y., also cans game fowl according to recipes developed by the famous chef, Louis P. DeGouy (author of THE GOLDEN COOK BOOK). Among the products offered are Wild Mallard Duck Stew, Wild Mallard Duck Soup, Pheasant à la Newburg, Pheasant Broth with Wild Rice, Breast of Pheasant with Sherry Wine and Truffles.

The Fin'n Feather Farm of Dundee, Illinois, also cans and markets such tidbits as Spaghetti Sauce with Game Bird Giblets, Barbecued and Smoked Turkey, Whole Ring-necked Pheasant, and Whole Mallard Duck. The Fin'n Feather Farm has a particularly attractive packaging for its products. It consists of a wooden box, which, when emptied, can be used for a birdhouse.

When James Rankin many years ago began raising ducks on a large scale in Massachusetts, he had to educate the American public to eat them. The whole game bird industry stands about where he did many years ago. The broad popular market has not even been touched. Many urbanites have scarcely heard of a quail or a partridge, much less eaten one. Game bird farming offers an almost unlimited opportunity.

try, involves using a temperature of 128 degrees to 130 degrees F. The birds must be held in the water for one-half to one minute before picking. They may then be picked without waxing.

The hard scald is the old farmer's method of dressing domestic fowl. The birds are scalded in water at a temperature of from 200 degrees to 212 degrees F. The birds are moved about in the water until a few trial pickings show that the feathers are coming off easily. This is the quickest hand method and most convenient for home consumption where the appearance of the skin



Bird house packing box of Fin'n'Feather Farm.

doesn't matter. In this method the thin yellow skin tissue comes off and the appearance of the bird is marred.

There are a number of machine pickers on the market which are advertised in poultry and turkey journals. Only large scale marketers will find these necessary.

Fancy packed game birds in full plumage are sold in braces, one male and one female in a box. One raiser prices the braces as follows (including shipping charges):

Pheasants	$13.75 a brace
Mallard Ducks	9.00 a brace
Bobwhite Quail	7.75 a brace
Chukar Partridge	12.50 a brace

Appendix 1

Official Organizations Concerned with Wildlife Protection

	Publications
UNITED STATES DEPARTMENT OF THE INTERIOR	
Fish and Wildlife Service, Chicago 54, Ill.	Annual report; text of Federal laws and regulations on wildlife and fisheries; North American Fauna; Fishery Bulletin; conservation research reports; bulletins; circulars; leaflets; posters on open seasons on migratory birds and on the migratory bird hunting stamp.
UNITED STATES DEPARTMENT OF AGRICULTURE	
Forest Service, Washington, D.C.	Annual report; statistical bulletins; farmers' bulletins; technical bulletins; department bulletins; statistics on forest game mammals; circulars; leaflets; yearbook separates; posters; miscellaneous publications.

Official Organizations in States and Territories

	Publications
ALABAMA	
Department of Conservation, Montgomery	Game and fish laws; regulations; division of game, fish, and seafood; annual report; Alabama Conservation (monthly).

GEORGIA	
State Game and Fish Commission, 412 State Capitol, Atlanta.	
HAWAII	
Board of Commissioners of Agriculture and Forestry, Honolulu 1, P.O. Box 3319.	Fish and game laws; reports.
IDAHO	
Department of Fish and Game, Boise	Fish and game laws; commission orders; annual report; Wildlife of Idaho; Big Game Map.
ILLINOIS	
Department of Conservation, Springfield.	Game and fish laws; Illinois Conservation (quarterly); Division of Forestry News (quarterly); bulletins on fishes, birds, snakes, and trees.
INDIANA	
Conservation Department, State Library Building, Indianapolis, 9.	Fish and game laws; yearbook; special bulletins and findings; Outdoor Indiana (monthly).
IOWA	
Iowa State Conservation Commission, Tenth and Mulberry Streets, Des Moines 8.	Fish and game laws; biennial report; Conservation Notes (weekly); Iowa Conservationist (monthly).
KANSAS	
Forestry, Fish and Game Commission, Pratt.	Fish and game laws; bulletins; biennial report; news service; pond fish culture; Kansas Fish and Game (monthly).
KENTUCKY	
Department of Conservation, Frankfort.	Fish and game laws; biennial report; educational bulletins.

ALASKA	
Alaska Game Commission, Juneau	Regulations relating to game, land fur animals, and birds (annual); Mammals and Birds of Alaska.
ARIZONA	
Arizona Game and Fish Commission, Phoenix	Digest of game laws; biennial reports.
ARKANSAS	
Arkansas Game and Fish Commission, State Capitol, Little Rock	Annual report; game and fish laws.
CALIFORNIA	
Department of Natural Resources, State Office Building, Sacramento.	Fish and game laws; biennial report; California Fish and Game (quarterly); fish bulletins.
COLORADO	
State Game and Fish Commission, 1350 Sherman Street, Denver	Game and fish laws; biennial report; Conservation Comments (quarterly).
CONNECTICUT	
State Board of Fisheries and Game, Hartford 1.	Game and fish laws; biennial report.
DELAWARE	
Board of Game and Fish Commissioners, Dover	Game and fish laws; annual report; Delaware Game and Fish News (monthly).
DISTRICT OF COLUMBIA	
Metropolitan Police, Washington. (Has jurisdiction over matters pertaining to game.)	
FLORIDA	
Game and Fresh Water Fish Commission, Tallahassee	Game and fish laws; miscellaneous pamphlets.

GEORGIA

State Game and Fish Commission, 412 State Capitol, Atlanta.

HAWAII

Board of Commissioners of Agriculture and Forestry, Honolulu 1, P.O. Box 3319. — Fish and game laws; reports.

IDAHO

Department of Fish and Game, Boise — Fish and game laws; commission orders; annual report; Wildlife of Idaho; Big Game Map.

ILLINOIS

Department of Conservation, Springfield. — Game and fish laws; Illinois Conservation (quarterly); Division of Forestry News (quarterly); bulletins on fishes, birds, snakes, and trees.

INDIANA

Conservation Department, State Library Building, Indianapolis, 9. — Fish and game laws; yearbook; special bulletins and findings; Outdoor Indiana (monthly).

IOWA

Iowa State Conservation Commission, Tenth and Mulberry Streets, Des Moines 8. — Fish and game laws; biennial report; Conservation Notes (weekly); Iowa Conservationist (monthly).

KANSAS

Forestry, Fish and Game Commission, Pratt. — Fish and game laws; bulletins; biennial report; news service; pond fish culture; Kansas Fish and Game (monthly).

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KENTUCKY	
Department of Conservation, Frankfort.	Fish and game laws; biennial report; educational bulletins.

LOUISIANA	
Department of Wildlife and Fisheries, Civil Courts Building, New Orleans 16.	Oyster, game and fish laws; bulletins; biennial report.
MAINE	
Department of Inland Fisheries and Game, State House, Augusta.	Fish and game laws.
MARYLAND	
The Board of Natural Resources, State Office Building, Annapolis.	Annual report; occasional bulletins.
MASSACHUSETTS	
Department of Conservation, 15 Ashburton Place, Boston 8	Fish and game laws; annual report; Conservation Bulletin (quarterly).
MICHIGAN	
Conservation Commission, Lansing 13.	Biennial report; game and fish laws; Michigan Conservation (monthly).
MINNESOTA	
Department of Conservation, State Office Building, St. Paul 1.	Game and fish laws; Conservation Volunteer (monthly); special reports.
MISSISSIPPI	
State Game and Fish Commission, 330 East Pearl Street, Jackson 104.	Game laws; press releases; reports; Mississippi Game and Fish (monthly).
MISSOURI	
State Conservation Commission, Jefferson City.	Wildlife and Forestry Code Book; Missouri Conservationist (monthly); annual report; Game Fish of Missouri (illustrated); wall chart of open seasons; special bulletins on specific subjects.

MONTANA	
State Fish and Game Commission, Helena.	Fish and game laws; biennial report; Montana Wildlife Bulletin (bimonthly).
NEBRASKA	
Game, Forestation, and Parks Commission, Lincoln 9.	Game and fish laws (annual); Outdoor Nebraska Magazine (quarterly).
NEVADA	
State Fish and Game Commission, Reno.	Fish and game laws; biennial report.
NEW HAMPSHIRE	
Fish and Game Department, State House Annex, Concord.	Fish and game laws; biennial report; technical papers.
NEW JERSEY	
Board of Fish and Game Commissioners, State House, Trenton.	Fish and game laws; annual report.
NEW MEXICO	
State Game and Fish Commission, Santa Fe.	Game and fish laws; reports; New Mexico Magazine (monthly).
NEW YORK	
Conservation Department, Albany.	Conservation laws, including forest, fish, and game laws; maps; annual report; bulletins on forestry and wildlife. Bimonthly magazine on conservation.
NORTH CAROLINA	
Department of Conservation and Development, Raleigh.	Conservation laws; game laws; biennial report; North Carolina Wildlife Conservation (monthly).

NORTH DAKOTA	
Game and Fish Department, Bismarck.	Game and fish laws; annual report; North Dakota Outdoors (monthly).
OHIO	
Department of Agriculture, Columbus.	The Ohio Conservation Bulletin (monthly); miscellaneous pamphlets.
OKLAHOMA	
State Game and Fish Commission, Oklahoma City 5.	Game and fish laws (biennial); biennial report; Fur Bearing and Game Mammals of Oklahoma; Upland Game Birds of Oklahoma; Management Suggestions for Owners of Small Ponds; A Survey of Game and Fur Bearing Animals of Oklahoma; A Game Type Map of Oklahoma: Operation Manual of Oklahoma Game and Fish Commission; Magazine (monthly).
OREGON	
State Game Commission, Oregon Building, Portland 4.	Game laws; biennial report.
PENNSYLVANIA	
Pennsylvania Game Commission, Harrisburg.	Game laws; bulletins; educational pamphlets; biennial report; Pennsylvania Game News (monthly).
PUERTO RICO	
Department of Agriculture and Commerce, San Juan.	
RHODE ISLAND	
Department of Agriculture and Conservation, State House, Providence 2.	Game laws; annual report.

SOUTH CAROLINA	
State Game and Fish Department, Columbia.	State game laws; game and fish laws; open seasons; annual report.
SOUTH DAKOTA	
Department of Game, Fish, and Parks, Pierre.	Game laws; annual report; booklets; South Dakota Conservation Digest (monthly).
TENNESSEE	
Department of Conservation, Nashville 10.	Game and fish laws; reports; The Tennessee Conservationist (monthly).
TEXAS	
Game, Fish, and Oyster Commission, Austin.	Game laws; annual reports; bulletins; Texas Game and Fish (monthly).
UTAH	
State Fish and Game Commission, State Capitol Building, Salt Lake City.	Fish and game laws; biennial report; bulletin (monthly).
VERMONT	
Department of Natural Resources, Montpelier.	Fish and game laws; biennial report; Hunting and Fishing in Vermont.
VIRGINIA	
Commission of Game and Inland Fisheries, Travelers Building, Richmond 13.	Game and fish laws; annual report; News Letter (monthly).
WASHINGTON	
State Game Commission, 515 Smith Tower, Seattle.	Seasons and bag limits on game and fur bearing animals, upland and migratory game birds, and game fish; biennial report.

WEST VIRGINIA	
Conservation Commission of West Virginia, Charleston.	Annual report; bulletins; West Virginia Conservation (monthly).
WISCONSIN	
Conservation Commission, Madison.	Hunting, fishing, and trapping laws; Wisconsin Conservation Bulletin (monthly); Waterfowl in Wisconsin; Pheasant Propagation Handbook; Wisconsin Wildlife—Birds.
WYOMING	
Wyoming Game and Fish Commission, Cheyenne.	Game and fish laws and regulations (annual); biennial report.

OFFICIAL ORGANIZATIONS IN CANADIAN PROVINCES AND TERRITORIES

	Publications
ALBERTA	
Department of Lands and Mines, Edmonton. (Has jurisdiction over matters pertaining to fish and game.)	
BRITISH COLUMBIA	
Game Commission, 540 Howe Street, Vancouver.	Game laws; bulletins; annual report; annual game and fishery regulations.
MANITOBA	
Department of Mines and Natural Resources, Winnipeg. (Has jurisdiction over matters pertaining to fish and game.)	Game and Fisheries Act; regulations.
NEW BRUNSWICK	
Department of Lands and Mines, Fredericton. (Has jurisdiction over matters pertaining to fish and game.)	Game laws; annual report.

NORTHWEST TERRITORIES	
Lands, Parks, and Forests Branches, Department of Mines and Resources, Ottawa, Ontario.	Annual report, Lands, Parks, and Forests Branch; Northwest Game Act; Regulations respecting game in the Northwest Territories.
NOVA SCOTIA	
Department of Lands and Forests, Halifax.	Game laws; annual report.
ONTARIO	
Department of Game and Fisheries, Parliament Buildings, Toronto.	Game laws; annual report.
PRINCE EDWARD ISLAND	
Department of Agriculture, Charlottetown.	Annual report.
QUEBEC	
Department of Game and Fisheries, Quebec.	Fish and game laws; annual report.
SASKATCHEWAN	
Department of Natural Resources, Regina. (Has jurisdiction over matters pertaining to fish and game.)	Annual report.
YUKON	
Office of Territorial Secretary, Dawson. (Furnishes information regarding game laws.)	
NEWFOUNDLAND GOVERNMENT ORGANIZATIONS	
Department of Natural Resources, St. Johns. (Address all communications to the secretary.)	Game laws.

Appendix 2

Publications on Game Birds

Current information on upland game birds may be found in the following periodicals:

Game Breeder and Sportsman.
Monthly. Game Conservation Society, Inc., 1819 Broadway, New York, N.Y. 25¢ a copy, $2.50 a year; Canada and foreign, $3 a year.

Modern Game Breeding and Hunting Club News.
Monthly. Western States Pheasant Society and American Pheasant Society, J. A. Gardy Printing Co., 28 W. State Street, Doylestown, Pa. United States and Canada, 25¢ a copy, $3 a year; foreign, $4 a year.

Journal of Wildlife Management.
Quarterly. Wildlife Society. P. F. English, Sec., 206 Forestry Building, Pennsylvania State College, State College, Pa. $1 a copy; $4 a year.

Transactions of the North American Wildlife Conferences.
Annual. American Wildlife Institute, Investment Building, Washington, D.C. $1 a copy.

Game Birds in General

Description and Range

Original and present breeding ranges of certain game birds in the United States. By Robert C. McClanahan. U.S. Dept. Int., Biol. Surv. Wildlife Leaflet BS-158, 21 pp., illus. April 1940. (Processed.) (FWS).

Game birds of Maine. By C. M. Aldous and H. L. Mendall. Univ. Maine Agr. Ext. Serv. Ext. Bul. 275, 38 pp., illus. Orono, Maine. 1940.

British and American game birds. By Hugh Pollard and Phyllis Barclay-Smith. 48 pp., illus. Charles Scribner's Sons, New York, N.Y. 1939.

Game birds, beasts, and fishes; natural history for sportsmen. By Eric Parker. 255 pp., illus. J. B. Lippincott Co., Philadelphia, Pa. 1935.

PHEASANTS

Description and Range

Ring-neck pheasant: General habits. By Robert McCormick. Ohio Dept. Agr., Div. Conserv., Bur. Sci. Res. Bul. 92, 3 pp. Columbus, Ohio. 1935.

Pheasants, their lives and homes. By William Beebe. Published under the auspices of N.Y. Zool. Society. Vol. 1, 257 pp., illus.; Vol. 2, 309 pp., illus. Doubleday, Page and Co., Garden City, N.Y. 1926 (Ed. in 1 vol. also available).

A history of the establishment of the ring-necked pheasant in California. By Henry A. Hjersman. Cal. Fish and Game. Mar. 15, 1947—Vol. 33—No. 1.

Food and Nutritional Requirements

An improved ration for starting ring-necked pheasants. By Winthrop Charles Skogland. Pa. State Coll., Sch. Agr. and Exp. Sta. Bul. 389, 22 pp., illus. 1940. (in collaboration with U.S. Fish and Wildlife Serv. and Pa. Game Comm.).

The food habits of the ring-necked pheasant. By Lawrence E. Hicks. Ohio Dept. Agr., Div. Conserv., Bur. Sci. Res. Bul. 107, 5 pp. Columbus, Ohio. 1936.

Management in the Wild

Analysis of pheasant reproduction, cover, utilization, and mortality. Wood County, Ohio: April to October 1, 1941. By Don H. Strode. Ohio Wildlife Res. Sta., Ohio State Univ., Release 173, 44 pp., illus. Columbus, Ohio. 1942. (Processed.).

Cover and its relations to pheasant production in Wood County, Ohio. By Daniel L. Leedy. Ohio Wildlife Res. Sta., Ohio State Univ., Release 86, 6 pp. Columbus, Ohio. 1938. (Processed.).

Wisconsin pheasant populations. By Irven O. Buss. Wisconsin Conservation Dept. Madison, Wis.

The Ring-Necked Pheasant and its management in Ohio. By D. L. Leedy & W. B. Hendershot. Ohio Division of Conservation, Columbus, Ohio.

The Ring-Necked Pheasant and its management in North America. Edited by W. L. McAtee. American Wildlife Institute, Washington, D.C.

The Ringed-Neck Pheasant—its history and habits. By Dana J. Leffingwell. The State College of Washington, Pullman, Washington.

Management in Captivity

Pheasant breeding manual. More Game Birds in America, Inc. Rev. ed., 63 pp., illus. 1939. Distributed by the Game Conservation Society. 1819 Broadway, New York, N.Y.

Pheasant propagation and management projects for 4-H Club members. By Russell G. Hill. Michigan State Coll., Ext. Div. Club Bul. 36, 33 pp., illus. E. Lansing, Mich. 1938.

Study of artificial incubation of game birds. I: Temperature requirements for pheasant and quail eggs; II: Humidity requirements for pheasant and quail eggs. By Alexis L. Romanoff. Cornell Univ. Agr. Exp. Sta. Bul. 616, 39 pp., illus. Ithaca, N.Y. 1934.

Study of artificial incubation of game birds. III: Effects of air movement on the incubation of pheasant and quail eggs; IV: Interrelation of temperature, humidity, and air movement in the incubation of pheasant and quail eggs. By Alexis L. Romanoff. Cornell Univ. Agr. Exp. Sta. Bul. 687, 30 pp., illus. Ithaca, N.Y. 1938.

Artificial incubation and brooding of ring-necked pheasants. Pa. Game Comm., Div. Prop. and Game Farms. 12 pp., illus. Harrisburg, Pa. 1936.

Ornamental pheasants, their breeding and care. By Charles F. Denley. 93 pp., illus. 1935. (Published by author, Glenmont, Md.).

Pheasant raising for the sportsman and farmer. Kansas Forestry, Fish, and Game Dept. 14 pp. Topeka, Kans. 1935.

Pheasant propagation handbook, Conservation Department, State of Wisconsin. Madison 2, Wis.

Restoration and Management in the Wild

Local bird refuges. By W. L. McAtee. U.S. Dept. Int., Fish and Wildlife Service. Conserv. Bul. 17, 17 pp., illus. 1942. (FWS).

Poverty or conservation: Your national problem. By Jay N. Darling. 29 pp. National Wildlife Federation, 1212 Sixteenth Street, N.W., Washington 6, D.C. 1944. 10¢

Shrubs for wildlife on farms in the Southeast. By Verne E. Davison. U.S. Dept. Agr. Leaflet 200, 7 pp. 1940. (GPO, 5¢).

Suggested action program for sportsmen's organizations. U.S. Dept. Int., Bur. Biol. Surv. Wildlife Leaflet BS-152, 5 pp. Feb. 1940. (Processed.) (FWS).

How to encourage wildlife. By Ralph T. King. Roosevelt Wildlife Forest Exp. Sta., N.Y. State Coll. For., 16 pp. Syracuse, N.Y. 1940.

Wildlife in land planning. By W. L. McAtee. U.S. Dept. Int., Bur. Biol. Surv. Wildlife Leaflet BS-160, 6 pp. April 1940. (Processed.) (FWS).

Fall combination plantings. Coop. Quail Study Assoc. Management Leaflet 1, 6 pp. Thomasville, Ga. Sept. 1940.

Game birds: how to make them pay on your farm. More Game Birds in America, Inc. 13 pp., illus. 1939. (Distributed by the Game Conservation Society, 1819 Broadway, New York, N.Y.).

Farming for wildlife. Simple methods by which farmers and sportsmen can improve wildlife habitats on agricultural lands. N.C. Dept. Conserv. and

Develop., Div. Game and Inland Fisheries. Wildlife Mangt. Ser. 2, 15 pp., illus. Raleigh, N.C. 1939.

The use of controlled fire in southeastern game management. By Herbert L. Stoddard. Coop. Quail Study Assoc. 21 pp. Sherwood Plantation, Thomasville, Ga. 1939.

Planting for wildlife management—an outline. U.S. Dept. Agr., Bur. Biol. Surv. Wildlife Res. and Mangt. Leaflet BS-107, 5 pp. March 1938. (Processed.) (FWS).

More upland game birds. Why game birds have decreased and how they can be restored. More Game Birds in America, Inc. 47 pp., illus. 1938. (Distributed by the Game Conservation Society, 1819 Broadway, New York, N.Y.).

Wildlife in the farm program. By James N. Morton. Pa. Game Comm. Bul. 16, ed. 2, 40 pp., illus. Harrisburg, Pa. 1938.

Plants useful in upland wildlife management. Conservation Bulletin 7, Fish & Wildlife Service.

Management in Captivity

Profitable game bird management. By Thomas Rae, Beacon Milling Co., 4th ed., 62 pp., illus. Cayuga, N.Y. 1941.

Upland game propagation. Western Cartridge Co., East Alton, Ill., Winchester Repeating Arms Co., New Haven, Conn., and Federal Cartridge Corp., Minneapolis, Minn. Rev. ed., 53 pp., illus. 1940.

Artificial incubation of upland game birds' eggs. By Alexis L. Romanoff; Gardiner Bump; and Earl Holm. N.Y. State Conserv. Dept. and N.Y. State Coll. of Agr., Cornell Univ. Bul. 2, 44 pp., illus. 1938.

Raising game birds. By Horace Mitchell. 315 pp., illus. Alfred A. Knopf, New York, N.Y. 1936.

The rearing of game birds in New York State. N.Y. Conserv. Dept., Bur. Game. 46 pp., illus. Albany, N.Y. 1936.

Artificial methods of propagating game birds. By August Bade. Reprint from California Fish and Game. Sacramento, Cal.

Predation Control

Publications on trapping. U.S. Dept. Int., Fish and Wildlife Serv. Wildlife Leaflet 194, 2 pp. July 1941. (Processed.) (FWS).

More game birds by controlling their natural enemies. More Game Birds in America, Inc. Rev. ed. 1935. (Distributed by Game Conservation Society. 1819 Broadway, New York, N.Y.).

Disease and Parasite Control

Disease of upland game birds. By J. E. Shillinger and L. C. Morley. U.S. Dept. Int., Fish and Wildlife Serv. Conserv. Bul. 21, 32 pp., illus. 1942. (FWS).

Poultry practices. A collection of discussions on poultry diseases and related subjects. By Leland D. Bushnell, and others. Veterinary Mag. Corp., Chicago, Ill. Diseases of game birds, by J. E. Shillinger and Don R. Coburn, pp. 143–145; Nematodes of domestic fowls transmissible to wild game birds, by Everett E. Wehr, pp. 136–142. 1940.

Poultry diseases: Their prevention and control. By Leland D. Bushnell, and M. J. Tweihaus. Kansas Agr. Exp. Sta. Bul. 284, 125 pp., illus. Manhattan, Kans. 1939.

Internal parasites of poultry. By Robert Graham; J. P. Torrey; J. D. Mizelle; and Viola M. Michael. Illinois Agr. Exp. Sta. Circ. 469, 50 pp., illus. Urbana, Illinois. 1937.

Diseases and parasites of poultry. By John S. Buckley; Hubert Bunyea; and Eloise B. Cram. U.S. Dept. Agr. Farmers' Bul. 1652, 66 pp., illus. 1935. (GPO, 5¢).

Flushing

Game bird flushing apparatus. By Paul D. Dalke. Connecticut State Board of Fisheries and Game. Game Mangt. Circ. 2, 2 pp., illus. Hartford, Conn. (Undated).

Merits of Liberated Stock

The liberation of pheasants in relation to reports of pheasants killed in Connecticut. Connecticut State Board of Fisheries and Game. Game Mangt. Circ. 5, 12 pp. Hartford, Conn. 1937.

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A simple method of sexing day-old ring-neck pheasant chicks. By Roger M. Latham. Pa. Game Comm. Res. Circ. 2, 11 pp., illus. Harrisburg, Pa. 1942.

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Description and Range

Bobwhite history. By M. E. Bogle. 47 pp., illus. 1938. $1. (Published by author, San Antonio, Tex.).

The bobwhite Quail. Its habits, preservation, and increase. By Herbert L. Stoddard. 559 pp., illus. Chas. Scribner's Sons, New York, N.Y. 1931.

Food

Some quail food plants in southeastern Texas. By S. R. Warner. Texas A and M. Coll., Texas Agr. Exp. Sta. Prog. Rep. 382A, 9 pp. College Station, Tex. 1940.

Winter foods of the bobwhite quail in the Black Belt soil province of Alabama. By Anderson M. Gray. Alabama Dept. Conserv. 23 pp., illus. Montgomery, Ala. 1938.

Quail-food plants of the Southeastern States. By Alec C. Martin. U.S. Dept. Agr. Circ. 348, 16 pp., illus. April 1935. (GPO, 5¢).

Management in the Wild

Essentials for more bobwhite quail in Missouri. By Harold V. Terrill, Missouri Conservatory Comm. Conserv. Bul. 2, 4 pp. Jefferson City, Mo. 1944.

The bobwhite quail in eastern Maryland. By Kenneth A. Wilson and Ernest A. Vaughn. Game and Inland Fish Comm. 138 pp., illus. Baltimore, Md. 1944.

Game bird investigation. Quail and chukar partridges. By E. M. Funk; James C. Hamilton; and H. L. Kempster. Univ. Missouri, Coll. Agr. Bul. 435, 16 pp. Columbia, Missouri. 1941.

Bobwhite populations as affected by woodland management in eastern Texas. By Daniel W. Lay. Texas Agr. Exp. Sta. Bul. 592, 37 pp., illus. College Station, Tex. 1940.

Factors in nesting losses of the California Valley Quail. By E. E. Horn. U.S. Dept. Agr., Bur. Biol. Surv. Wildlife Res. and Mangt. Leaflet BS-124, 7 pp. Jan. 1939 (Processed.) (FWS).

Bobwhite development of the Glassboro public shooting grounds. By L. G. MacNamara. New Jersey Fish and Game Comm. 10 pp., illus. Trenton, N.J. 1938.

Habitat improvement for quail. By Valgene W. Lehmann. Texas Game, Fish, and Oyster Comm., Div. Wildlife Restor. Bul. 17, 11 pp., illus. Austin, Tex. 1939.

Fenced areas for bobwhite. By Valgene W. Lehmann. Texas Game, Fish, and Oyster Comm. Bul. 12, 2 pp. illus. Austin, Tex. 1938.

Requirements for quail in Missouri. By Harold Terrill. Missouri State Conserv. Comm. 6 pp., illus. Jefferson City, Mo. 1938.

Increase quail by improving their habitat. By Valgene W. Lehmann. Texas Game, Fish, and Oyster Comm. 44 pp., illus. Austin, Tex. 1937.

Feeding stations and shelters for quail on Missouri farms. By Werner O. Nagel and Rudolp Bennitt. Univ. Missouri. Coll. Agr. Ext. Ser. Circ. 358. 8 pp. illus. Columbia, Mo. 1937.

Food and Nutritional Requirements

Food crops for game birds on farm lands. By Allen M. Pearson and D. G. Sturkie. Alabama Polytecbnic Inst., Agr. Exp. Sta. Circ. 90, 20 pp., illus. Auburn, Ala. 1944.

The place of winter feeding in practical wildlife management. By Richard Gerstell. Pa. Game Comm. Res. Bul. 3, 121 pp., illus. Harrisburg, Pa. 1942.

Feeding requirements of gallinaceous upland game birds. By Ralph B. Nestler. U.S. Dept. Agr. Yearbook Sep. 1718, pp. 893–924, illus. 1940. (Out of print.) (From Food and Life, U.S. Dept. Agr. Yearbook, 1939.)

Wildlife food strip planting. Rhode Island Agr. Exp. Sta. Misc. Publ. 2, 3 pp. Kingston, R.I. Feb. 1939.

Legumes: Their erosion-control and wildlife values. By Edward H. Graham. U.S. Dept. Agr., Soil Conserv. Serv. SCS-TP 23, 122 pp. Washington 25, D.C. 1939.

Planting food crops for game birds. By Allen M. Pearson and J. W. Webb. Alabama Polytechnic Inst., Agr. Exp. Sta. 6 pp., illus. Auburn, Ala. 1939.

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Fruits attractive to birds. By W. L. McAtee. U.S. Dept. Agr., Bur. Biol. Surv. Wildlife Res. and Mangt. Leaflets BS 41 to 50. April 1936. (Processed.) (FWS).

Leaflets 41, Northwestern States; 42, Rocky Mountain States; 43, Northern Plains States; 44, Nortbeastern States; 45, California; 46, Great Basin States; 47, Southwestern States; 48, Southern Plains States; 49, Southeastern States; 50, Florida.

More food for upland game. By W. Gard Conklin and James N. Morton. Pa. Game Comm. Bul. 11, 40 pp., illus. Harrisburg, Pa. 1936.

Winter feeding of North Dakota birds. By Adrian C. Fox. U.S. Dept. Agr., Soil Conserv. Serv., N. Dak. (Park River, N. Dak.) Proj. 1, 13 pp., illus. 1936.

Mechanic value of grit for bobwhite quail. By Ralph B. Nestler. Reprint from Journal of Wildlife Management, Vol. 10, No. 2, April 1946.

Food particle size and quality in relation to disease in artificially propagated quail chicks. By Don R. Coburn, D.V.M. and Ralph Nestler, M.S.

Value of wild feedstuffs for pen-reared bobwhite quail in winter. By Ralph B. Nestler, W. W. Bailey, A. C. Martin & H. E. McClure.

Picking among pen-reared bobwhite quail. By Ralph B. Nestler, Don R. Coburn and Harry W. Titus.

Vitamin A requirements in game birds. By Ralph B. Nestler, R. Stow and W. R. Kauffmann.

(Additional information on this subject can be found in the publications listed under Restoration and Management in the Wild).

Management in Captivity

Bobwhite quail propagation. By Ralph B. Nestler and Woodrow W. Bailey. U.S. Dept. Int., Fish and Wildlife Serv. Conserv. Bul. 10, 50 pp., illus. 1941. (FWS).

Raising bobwhite quail in the sportsmen's pens. By Charles W. Wessell. Pa. Game Comm. 8 pp., illus. Harrisburg, Pa. 1939.

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Inbreeding among pen-reared quail. By Ralph B. Nestler and Arnold L. Nelson. Reprint from The Auk, Vol. 62, April 1945.

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Report on the Arnett, Oklahoma, experimental quail and prairie chicken management project. By Verne Davison. (Abridged by W. L. McAtee.) U.S. Dept. Agr., Bur. Biol. Surv. Wildlife Res. and Mangt. Leaflet BS-39, 6 pp. March 1936. (Processed.) (FWS).

Wildlife management in North Carolina. N.C. Dept. Conserv. and Develop., Div. Game and Inland Fisheries. 15 pp. illus. Raleigh N.C. 1938.

Game management on the farm. By J. N. Darling; H. P. Sheldon; and Ira N. Gabrielson. U.S. Dept. Agr. Farmers' Bul. 1759, 22 pp., illus. Oct. 1936. (GPO, 5¢).

Game management. By Aldo Leopold. 481 pp. Chas. Scribner's Sons, New York, N.Y. 1936.

Groups of plants valuable for wildlife utilization and erosion control. By W. L. McAtee, U.S. Dept. Agr. Circ. 412, 12 pp., illus. Oct. 1936. (GPO, 5¢).

More food and shelter for West Virginia's upland game. A manual on cultivation of the game seed stock by increasing natural shelter and food resources and by feeding in winter. W. Va. Conserv. Comm. 29 pp., illus. Charleston, W.Va. 1936.

Improving food and cover for wildlife on Missouri farms. By R. H. Westveld and Rudolf Bennitt. Univ. Missouri Agr. Exp. Sta. Circ. 348, 8 pp., illus. Columbia, Mo. 1936.

Wings, fur and shot: A grass-roots guide to American hunting, wherein is included a practical study of wildlife habits, conservation and other sensible matters designed to make hunting a greater sport. By Robert Vale. 199 pp. illus. Stackpole Sons, New York, N.Y., and Harrisburg, Pa. 1936.

Propagation of game food and cover plants of the Lake States. By P. L. Fisher; A. H. Briggs; W. A. Elbims; E. S. Roe; and C. M. Aldous. U.S. Dept. Agr., Lake States Forest Exp. Sta., in coop. with Univ. Minn. 81 pp., illus. St. Paul, Minn. 1935.

Planting guide of trees, shrubs, vines, and evergreens recommended for gamebird cover and food in South Dakota and North Dakota. By Adrian C. Fox. U.S. Dept. Agr., Soil Conserv. (Huron, S. Dak.) 17 pp., illus. 1935.

Suggestions for increasing the game in Connecticut by improving the environment. By Paul D. Dalke. Connecticut State Board of Fisheries and Game, Game Mangt. Circ. 3, 6 pp., illus. Hartford, Conn. (Undated).

Feeding stations and shelters for quail on Missouri farms. By Werner O. Nagel and Rudolph Bennitt. Columbia, Missouri.

(Further information on this subject can be found in the Publications listed under Food and Nutritional Requirements).

Partridges

The chukar and Hungarian partridges in America. By Clarence Cottam; Arnold L. Nelson; and Lawrence W. Saylor. U.S. Dept. Int., Bur. Biol. Surv. Wildlife Leaflet BS-159, 6 pp. April 1940. (Processed.) (FWS).

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Influence of rainfall and soil on Hungarian partridges and pheasants in southeastern Michigan. By F. H. Dale, Jour. Wildl. Mgt., 6: 17–18. 1942.

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Birds of Massachusetts and other New England states. By E. H. Forbush, Boston, Mass. Dept. Agric., Vol. 2. 1925.

Partridge breeding. By J. C. Hunting, Amer. Game, 18: 37, 40. 1929.

Report on a game survey of the north central states. By Aldo Leopold, Madison, Wis. 1931.

Biology of the Hungarian Partridge (Review of "Zur Biologie des Rephuhns" by W. Nolte; Berlin, 1934). By Aldo Leopold, Wilson Bul., 45: 300–303. 1935.

Farm game management in Silesia. By Aldo Leopold, Penna. Game News, 7 (12): 12–13, 28. 1937.
Partridges and partridge manors. By A. Maxwell, London, Adam and Charles Black. 1911.
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The population of partridges (Perdix perdix) in Great Britain during 1936. By A. D. Middleton, Journ. Animal Ecol., 6: 318–321. 1937.
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The Hungarian partridge in Northwest Iowa. By C. J. Spiker, Wilson Bul., 41: 24–29. 1929.
History and status of Hungarian partridge in Michigan. By Fred H. Dale.
The Chukar Partridge in California. By August Bade, Cal. Fish and Game, Vol. 23, No. 3.

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Physiological Variations in Wild Turkeys and their significance in Management, Research Bulletin No. 2, Penn. Game Commission, Harrisburg, Pa.
Life History and Management of the Wild Turkey in Pennsylvania. By Edward L. Kozicky, Unpublished Ph. D. Thesis, Penn. State College.
The Wild Turkey in Virginia. By H. S. Mosby and C. O. Handley, Commission of Game and Inland Fisheries, Richmond, Virginia.

Waterfowl

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Sportsman's guide to wild ducks. Wildlife Management Institute, Washington, D.C.
Waterfowl in Iowa. Iowa State Conservation Commission, Des Moines, Iowa.
Michigan waterfowl management. By M. D. Pirnie. Dept. of Conservation, Lansing, Michigan.
Wild geese. Bulletin No. 28. Published by the authors, Mr. & Mrs. J. L. Peyton. Route 2, Box 743, Duluth, Minnesota.
Propagation of aquatic game birds. Conservation Bulletin 29. Fish and Wildlife Service, U.S. Dept. of the Interior, Washington, D.C.
Waterfowl management on small areas. Wildlife Management Institute, Washington, D.C.

Index